341 EAST OHIO STREET SITE

QUALITY ASSURANCE PROJECT PLAN

SEPTEMBER 21, 2001

JULIE APOLINARIO
PROJECT MANAGER

RICHARD G. BERGGREEN, C.P.G.
PROJECT COORDINATOR

341 EAST OHIO STREET SITE

QUALITY ASSURANCE PROJECT PLAN

ATTACHMENT 2

Title: Quality Assurance Project Plan

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Mr. Fred Micke, On-Scene Coordinator
U.S. Environmental Protection Agency, Region 5
77 W. Jackson Boulevard, SE-5J
Chicago, Illinois 60604

Ms. Verneta Simon, On-Scene Coordinator
U.S. Environmental Protection Agency, Region 5
77 W. Jackson Boulevard, SE-5J
Chicago, Illinois 60604

Mr. Thomas Pabian
Capri Capital
1201 N. Clark Street, Suite 300
Chicago, Illinois 60601

Mr. Timothy Ramsey
Piper Marbury Rudnick & Wolfe
203 N. LaSalle Street, Suite 1800
Chicago, Illinois 60601

Mr. Bernard Bono, P.E.
Kerr McGee
800 Weyrauch Street
West Chicago, Illinois 60185

Mr. Glen Huber
Stan A. Huber Consultants, Inc.
200 N. Cedar Road
New Lenox, Illinois 60451-1751

LIST OF ACRONYMS

CFR	Code of Federal Regulations
DQO	Data Quality Objective
EPA	Environmental Protection Agency
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PE	Performance Evaluation
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
SOP	Standard Operating Procedure
UAO	Unilateral Administrative Order

PROJECT/TASK ORGANIZATION

ELEMENT A4

The management structure under which the project will be accomplished is illustrated in Figure 1 of this Quality Assurance Project Plan (QAPP). The Project Team consists of U.S. Environmental Protection Agency (USEPA) and it's support organizations; Teachers' Retirement System of the State of Illinois (TRS) and its consultants; the construction team comprised of STS Consultants, Ltd. (STS), their contractors and subcontractors; and Kerr-McGee Chemical, LLC and their contractors involved in the transportation and disposal tasks.

This QAPP presents the organization, objectives, functional activities and specific quality assurance (QA) activities associated with the excavation and verification sampling at the GMO Site. All QA procedures will be in accordance with applicable professional technical standards, USEPA requirements, government regulation and guidelines, and specific project goals and requirements. This QAPP is prepared by STS Consultants, Ltd. (STS) in accordance with USEPA QAPP guidance documents, in particular, the Region 5 Instruction on the Preparation of a Superfund Division Quality Assurance Project Plan, Revision 0 and on the EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5).

The duties and responsibilities of these positions and organizations are summarized below.

A. Management Responsibilities

STS will supply the Project Coordinator who will provide overall direction to project activities and has overall responsibility for ensuring that the project meets USEPA objectives and quality standards. These responsibilities include communications between the project team and USEPA, and among the various members of the project team, including Kerr-McGee, the Health Physics subcontractor, the excavation contractors, and other subcontractors on the project. The Project Coordinator is the administrative point of contact between TRS and the USEPA. The position descriptions are included in Appendix A of the QAPP.

The TRS Project Manager, who will be responsible for communication between TRS and the project team, will represent TRS. The TRS Project Manager will review project documents, plans, and progress reports to confirm the plans and implementation are consistent with TRS objectives.

The STS Project Manager will be responsible for the day-to-day implementation of the Work Plan and this QAPP Plan. The Project Manager's primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. This will include coordination of schedules with the contractors and subcontractors, planning and scheduling activities with the USEPA to provide for verification of remediated locations, and documentation of activities as provided for in this Remediation Work Plan. The STS Project Manager may not be on-site daily, but will make inspection visits to the Site.

USEPA will be represented by its On-Scene Coordinators (OSC), whom will be Mr. Fred Micke and Ms. Verneta Simon. The OSC is responsible for directing and/or overseeing and coordinating all project activities. He or she is responsible for submitting QAPP and QAPP revisions and amendments to appropriate personnel for review and approval. Mr. Larry Jensen, Regional Radiation Expert and other support staff will assist the OSCs.

Kerr-McGee will be responsible for transportation and disposal of the radiologically impacted materials excavated and removed from the site. That responsibility includes health physics personnel to survey the transport containers, subcontractor transportation and logistics personnel, and documentation for shipping and disposal. The disposal is proposed to be under an existing contract with Envirocare of Utah, Inc. In the event Kerr-

McGee is unable to fulfill this role, a logistics subcontractor will be available to complete this work.

B. QA Responsibilities

The Project Quality Assurance Supervisor will provide guidance on QA issues. The Project QA Supervisor is responsible for developing programs and tools to implement and monitor the QAPP plan. Specific functions and duties of the Project QA Supervisor include: provide QA audits on various phases of the field operations; review and approve of QA plans and procedures; provide QA technical assistance to project staff; and report on the adequacy, status, and effectiveness of the QA program on a regular basis to the Project Manager. The USEPA Region 5 Superfund QA Reviewer has the responsibility to review and approve QAPPs.

The Project QA Supervisor will provide the Project Coordinator copies of reports pertaining to quality assurance/quality control (QA/QC). The Project QA Supervisor functions independently from the personnel directly responsible for accomplishing the excavation and removal. He/she reports to the Project Coordinator and the TRS Project Manager and has access to higher levels of management with whom he/she can consult to resolve quality related project issues. The Project QA Supervisor will be responsible for internal and external performance and system audits. The Project Supervisor will be responsible for data assessment and validation.

C. Field Responsibilities

The Field Team Leader is responsible for coordinating the field activities, in particular coordinating the excavation and health physics technician subcontractors. The Field Team Leader will be responsible for day-to-day communications with the USEPA's OSC whenever the OSCs are on site. The Field Team Leader will be responsible for identifying and documenting non-conformance.

D. Laboratory Responsibilities

Argonne National Laboratory will provide laboratory subcontract services to USEPA for radiological analysis of samples from this project. A field laboratory will be used to analyze samples onsite. The Health Physics subcontractor, Stan A. Huber Consultants, Inc., will manage this laboratory. Off-site laboratory services will be provided by Severn Trent Laboratories (STL) of St. Louis; Missouri, RSSI of Morton Grove, Illinois; and Grace Laboratories of Chicago, Illinois. STL will perform waste characterization analyses, RSSI will serve in a back up capacity to STL, and Grace Labs will perform the potential groundwater analysis.

STL will perform the following analyses:

- Gamma spectroscopy
- TCLP Extraction
- TCLP Extraction – ZHE
- Volatiles
- Semi-Volatiles
- Pesticides (Organochlorine)
- Herbicides (Organochlorine)
- RCRA Metals
- Corrosivity (pH)
- Paint Filter
- Reactive Sulfide
- Reactive Cyanide
- Ignitability (Flashpoint)

Grace Labs will perform the following groundwater analyses if determined necessary:

Waste or Chemical	Concentration (mg/L)
Cadmium	0.11
Chromium (total)	2.77
Copper	2.07
Cyanide (total)	1.20
Fats, Oils and Greases (FOG) (total)	250.0
Iron	250.0
Lead	0.5
Mercury	0.0005
Nickel	3.98
Zinc	2.61
Dichloromethane	0.294
Chloroform	0.309
1,1,1-Trichloroethane	0.193
Trichloroethylene	0.242
Benzene	0.278
Tetrachloroethene	0.225
Toluene	0.247
Ethylbenzene	0.329
Volatile Organic Compounds (total)*	0.567
Total Toxic Organics**	2.13

pH Range - Not lower than 5.0 or greater than 10.0

Temperatures of liquids or vapors at point of entrance to the sewerage system shall not exceed 150°F.

* Total Volatile Organic Compounds shall be the arithmetic sum of the concentrations of:

dichloromethane
chloroform
1,1,1-trichloroethane
trichloroethylene
benzene
tetrachloroethene
toluene
ethylbenzene
acrolein
acrylonitrile

1,3-butadiene
carbon tetrachloride
chlorobenzene
dichloroethane
dichlorobenzene
1-ethyl 2-methylbenzene
napthalene
styrene
1,3,5-trimethylbenzene
vinyl chloride
xylenes
1,4-dioxane
ethylene dibromide
methyl ethyl ketone

** Total Toxic Organics shall be the arithmetic sum of the concentrations of those pollutants found under Title 40 Part 413.02(i) of the Code of Federal Regulations.

E. Special Training Requirements/Certification

All of the designated technical team members possess the degree of specialization and technical competence to effectively and efficiently perform the required work. All team members visiting the site will be trained and certified in accordance with 29 CFR 1910.120, as described in the Health and Safety Plan (Attachment 3 of the Remediation Work Plan).

F. Project Management Organization Chart

The Project Management Organization Chart shows the relationships and the lines of communication among all project participants, including the USEPA. The organization chart identifies subcontractor relationships relevant to environmental data operations.

PROBLEM DEFINITION/BACKGROUND INFORMATION

ELEMENT A5

The subject site for this Work Plan and QAPP is a vacant parcel of approximately 2.16 acres located at 341 E. Ohio Street, Chicago, Illinois and is depicted on Figure 1-1 of the Removal Action Work Plan. The site is currently a vacant, at-grade paved parking lot; however, the site is not presently being used for parking. TRS previously made a mortgage loan secured by the site and after such mortgage went into default, TRS subsequently acquired the site by deeds in lieu of foreclosure.

The site is across the street (north of East Grand Avenue) from the site at 316 East Illinois Street in Chicago, Illinois which is owned by River East, LLC, and on which radiological impacted soils were previously detected by the USEPA. USEPA determined that the radiologically impacted soil at the 316 East Illinois Street site was associated with the former operations of Lindsay Light Company at 161 East Grand Avenue. On June 6, 1996, USEPA issued a Unilateral Administrative Order ("UAO") pursuant to Section 106 of the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA") to the Chicago Dock and Canal Trust (now known as River East LLC) and to Kerr-McGee Chemical Company (the corporate successor of Lindsay Light Company and now known as Kerr-McGee Chemical, LLC) requiring River East and Kerr-McGee to perform a removal action with respect to the radiologically impacted soil on the 316 East Illinois Street site (which USEPA designated "Lindsay Light II") and on any areas off the Lindsay Light II site on which such radiologically impacted soils were found. Subsequently, radiological impacts were discovered at the site which was owned by Grand Pier Center, LLC immediately to the west of (and across Columbus Drive) Lindsay Light II and which was designated by USEPA as "Lindsay Light II/RV3 North Columbus Drive". USEPA determined that the radiological impacts at Lindsay Light II/RV3 North Columbus Drive were associated with the former operations of Lindsay Light Company. On March 29, 2000, USEPA amended the UAO to require Kerr-McGee, River East and Grand Pier to perform removal action at Lindsay LightII/RV3 North Columbus Drive.

TRS has previously entered into a contract to sell the subject site to a third party purchaser that engaged environmental consultants to perform environmental investigations of the site. B. Koh & Associates, Inc. ("Koh") performed a radiological investigation of the site including surface gamma radiation readings, down-hole radiation readings and soil sampling and analysis. Koh's report dated May 2000 documented its findings of elevated gamma radiation and radiological concentrations at the site. TRS reported the findings in the Koh report to USEPA. On March 1, 2001, USEPA issued an Action Memorandum Amendment setting forth determinations by USEPA that, among other things, (1) the radiological impacts at the site are associated with the former operations of Lindsay Light Company and (2) the UAO requires Kerr-McGee to proceed with a removal action with respect to the radiological impacts at the site.

TRS has made demand on Kerr-McGee to perform all removal actions required at the site but Kerr-McGee has not agreed to perform all such removal actions. In order to provide for the performance of the removal actions, TRS and Kerr-McGee have agreed that (1) TRS will perform excavation, screening and sampling at the site as described in this Removal Action Work Plan, (2) Kerr-McGee will transport and dispose of the radiologically impacted soils removed from the site, and (3) TRS and Kerr-McGee reserve their rights to, among other things, recover their costs with respect to their respective work activities which they will perform with respect to the site.

The following reports of previous environmental investigations were provided by TRS for the preparation of this Removal Action Work Plan.

- Letter dated August 22, 1990 from OHM Corporation to GMO Limited Partnership
- Environmental Site Assessment dated August 28, 1990 prepared by Professional Service Industries, Inc.
- Visual Site Inspection dated December 30, 1993 prepared by USEPA, Region 5, with attached Preliminary Assessment/Visual Site Inspection Report dated December 16, 1993 prepared by PRC Environmental Management, Inc.

- Preliminary Environmental Review dated March 8, 2000, prepared by GaiaTech, Inc.
- A Phase II Soil and Groundwater Investigation Report Time-Life Property, Grand Avenue and McClurg Court, Chicago, Illinois, dated May 11, 2000, prepared by GaiaTech, Inc.
- Summary of Radiological Survey Time-Life Property, Chicago, Illinois, dated May 2000, prepared by B. Koh & Associates, Inc.
- Scanner Van Survey of the Chicago, Illinois Streeterville area dated July 12, 2000 prepared by USEPA Radiation and Indoor Environments National Laboratory.

The intent of the removal actions is to perform the site survey, identify impacted soil and materials, and remove all impacted soil and materials to the proposed cleanup threshold of 7.1 pCi/g total radium (Ra-226 + Ra-228). The following activities must be accomplished to complete the project:

- All identified radiologically impacted material above the proposed cleanup threshold of 7.1 pCi/g total radium (Ra-226 + Ra-228) has been removed from the site
- TRS has received USEPA verification sign-off that all radiologically impacted materials above the cleanup threshold have been removed from the site
- Equipment and personnel have been demobilized from the site
- TRS has submitted the required documentation to USEPA for closure of the site
- USEPA has responded acknowledging the sufficiency of the removal and documentation, in accordance with the UAO and Amendments

PROJECT/TASK DESCRIPTION AND SCHEDULE

ELEMENT A6

A Project Tasks

There are three phases of removal work: the Investigation and Delineation Phase; the Initial Contaminant Removal Phase; and the Site-wide Excavation, Monitoring, and Removal Phase. The Investigation and Delineation Phase was begun with the survey and sampling work previously completed by Koh as reported in their May 2000 report. This phase will continue with the site surveys to be conducted as the asphalt pavement is removed. The Initial Contaminant Removal Phase will consist of the removal of the radiologically impacted zones identified in Phase 1. Finally, the Site-wide Excavation, Monitoring and Removal Phase will involve the surveying of all fill soils on-site, and the segregation and removal for disposal of all radiologically impacted soils encountered. A more complete description of these activities is presented in Section 3.0 - Methodology of the Remediation Work Plan.

Task 1 - Investigation/Delineation Phase, Project Quality Objective.

On May 31, 2000, TRS informed USEPA that elevated levels of radioactive materials had been detected at the GMO property. This notification was based on the Koh report dated May 2000, which documented the presence of seven locations on site that exhibited gamma radiation levels above background levels, and the results of radiologic analysis showing radioactivity levels requiring removal. This information was supported by the USEPA Scanner Van radiation survey of the GMO property and a gamma survey meter walkover by USEPA staff. Following this disclosure, TRS, Kerr-McGee LLC, and USEPA met several times to discuss the extent of the contamination on the GMO property and make preparations for its cleanup. Also, a letter was sent to TRS and Kerr-McGee on July 13, 2000. This letter addressed the need to prepare a Remediation Work Plan for a site cleanup in accordance with the June 6, 1996 UAO.

The project quality objectives for the proposed work plan are threefold. The removal is intended to result in all soil above the clean-up criteria of 7.1 pCi/g total radium being removed from the site. Field and laboratory data quality and minimum detection limits must be sufficient to confirm that all soils exceeding this threshold have been removed. Achieving this objective will result in unrestricted use of the property with regard to radiologic impacts.

The second objective is to confirm that all radiologically impacted soils are disposed at facilities licensed to accept these materials. The Work Plan covers the removal of the radiologically impacted soils for disposal at Envirocare of Utah, Clive, Utah. Other materials, which may be removed from the site, include the asphalt pavement, large demolition rubble such as foundation walls or floor slabs, and possible chemically contaminated materials unsuitable for use as backfill. The screening criteria (7.1 pCi/g) and data quality objectives (disposal at a facility permitted for the material) for the non-radiological material excavated from the site, i.e., pavement and chemically impacted material, will be the same as for the uncontaminated soil which remains on site. The larger blocks of demolition debris will be cleared by frisking and wipes in accordance with requirements per 32 IAC Part 340 Appendix A for off-site release of equipment.

The third objective is to confirm that all personnel working on the site are working under conditions that reduce or eliminate potential exposure to contamination. The air monitoring, film badge monitoring, and PPE requirements specified in the Health and Safety Plan, Attachment 3 to the Work Plan provide for those objectives to be met.

As the project progresses and areas are remediated, the documentation of clean closure will be generated by USEPA. The remedial objective of removing all radiologically impacted soil will be met when the project site has been documented as having met the clean-up criteria over the entire parcel and USEPA acknowledges the removal action is complete.

Task 2 - Target Compounds

The Lindsay Light Company produced incandescent gas mantles near the GMO site. Some manufacturing and/or processing of thorium-bearing monazite sand reportedly took place at the 316 East Illinois Street site. A principal ingredient in gas mantle manufacture is thorium as a nitrate. Small amounts of cerium, beryllium, and magnesium nitrates are also used. Thorium was extracted from the monazite sand using an acid leach. The gas mantles were then dipped into a solution containing the thorium nitrate to provide the mantle's incandescence strength.

Thorium occurs in nature principally as the parent radionuclide Thorium-232 in association with its daughter products in a decay sequence known as the Thorium Decay Series. It is believed that the principal source of contamination at this site is Thorium 232 and thorium decay series nuclides. Cleanup levels will be based on total radium, Ra-226 and Ra-228. The clean-up level specified by USEPA is 5 pCi/g total radium above the background level. Background levels have been determined on vicinity properties to be 2.1 pCi/g total radium. This results in a clean-up criteria of 7.1 pCi/g total radium.

Radiologic analysis of soils from the subject site were performed in May 2000. The results of those analyses indicated the presence of thorium and thorium decay chain compounds only. This would include Ra-228, but not Ra-226. Results as high as 2880 pCi/g of thorium 288 were measured. Analysis for the surrogate Ac-228 on the same sample measured 2110 pCi/g.

Task 3 - Sampling Rationale

The radioactive materials are present in the soil and urban fill. No evidence of groundwater contamination has been identified. Any water removal from the site will be allowed to settle any suspended sediment before discharge. Fugitive dust will be monitored. The principal matrix of concern is soil contamination. The following will be completed prior to any site work:

- The site grid at 5 meter spacing will be established.
- The site boundaries will be located and marked.
- The location of all surface features such as the guardrail, storm drain catch basins, utility vaults, light standards, etc. will be mapped.
- A photographic record of the site will be made and retained in the project files.

The beginning of the removal work task will be to begin removal of the asphalt pavement cover in stages. Once the asphalt paving is removed from each area of the site, 100% of the soil surface in each such area will be surveyed for elevated gamma readings. The survey will cover the exposed soil on survey lines spaced 5 meters. Gamma count values shall be taken at intervals spaced 5 meters (5 x 5 meter grid). The site grid will be marked by stakes and flagging at the edges of the property and by paint on the ground surface on the interior of the site. The areas between the grid points will be scanned following the Gamma Radiation Survey Procedure SOP 210 so as to cover the intra-grid areas. Each exclusion zone will be verified as meeting the clean-up criteria in accordance with the Verification Sampling Procedure, SOP-223.

The sample network design and rationale for sample locations are described in detail in the Field Sampling Plan (FSP) (Appendix 9 of the Remediation Work Plan).

Task 4 - Analytical Rationale

Sample matrices, analytical parameters, and frequencies of sample collection are shown in Table 1-1. The waste characterization analyses are for the purpose of documenting whether the material proposed for disposal at Envirocare of Utah is a RCRA hazardous waste. That demonstration will involve testing for parameters to evaluate the material for characteristic hazardous waste. SOPs for the waste characterization and groundwater analyses to be performed can be found in Appendix B.

Should it be necessary to discharge water into the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) combined storm and sanitary sewer system, analysis will meet the MWRDGC Appendix A discharge parameters list.

Other analyses are for the radiological constituents of concern. Constituents of concern for the removal documentation analysis have been selected based on constituents that represent the known contaminants. The constituents of concern are the entire thorium and uranium decay series; however, measurements will only be made for Ra-226 and Ra-228.

Soil samples will be analyzed for Ra-226 and Ra-228. Sample splits will be performed in the laboratory. Verification analyses will be performed on sub-sets of six samples. It is not proposed to analyze split samples due to the potential for heterogeneous materials

TABLE 1: SUMMARY TABLE OF SAMPLING AND ANALYSIS PROGRAM

Matrix	Lab/# of Samples			
	Severn Trent	RSSI	Field Lab S.A. Huber	Argonne National Lab
Soil Waste Characterization[1] Field Blank Trip Blank Lab Dup	 10 1 1 2			
Soil (Removal Action)[2] Estimate 5/day x 16 weeks x 5 day/week		Back-up capacity	Minimum 1 per exclusion zone, plus excavation monitoring- estimate 400	As requested
Groundwater (MWRDGC Discharge Permit Application)[3] Lab Dup Trip Blank	 1 1 1			
Soil (Closure Verification)[2] approx. 8,900 m^2. 6 samples per 100 m^2		Back-up capacity	6 per 100 m^2; est. 534	6 per 100 m^2; est. 534
Air (perimeter monitoring, personal air monitoring)[4] Daily Perimeter (4/day, 16 weeks x 5 days) Daily PAM (estimate 2/day x 16 weeks x 5 day)		Back-up capacity	Perimeter, 4 daily = 320 PAM, est. 2 daily = 160	
Soil (Lab cross validation) same set of 10 samples rotated to each laboratory		1 set, 10 samples	1 set, 10 samples	1 set, 10 samples

[1] Waste Characterization: TCLP volatiles, TCLP semi-volatiles, TCLP metals, herbicides, pesticides, gamma spec.
[2] Removal Action, Closure Verification: Radium-226, measured directly or using lead 214 as a surrogate. Radium-228, using actinum 228 as a surrogate. Nutranl system analysis by S.A. Huber or RSSI. High Resolution germanium detector by Argonne.
[3] MWRDGC Discharge Permit application: Appendix A pretreatment standards including gross alpha and gross beta.
[4] Site perimeter Air Monitoring, Personal Air Monitoring: alpha radiation emitters.

producing disparate results. Rather, the same samples will be run in each laboratory to provide for comparison of results on the same soil material.

The on-site laboratory Standard Operating Procedures (SOPs) for radiological analysis of samples will be used for this project. These project-required SOPs are included in Appendix B. TRS will provide the samples on a routine basis at the request of the USEPA. Air samples will be analyzed for gross alpha. Air samples will not be split. The procedures for radiological surveys are described in the FSP.

Air monitoring activities will also be a part of this QAPP. Airborne radioactivity data will be collected to evaluate the effectiveness of work procedures and site control measures. In addition to identifying the need for procedure modification, air monitoring also documents the effectiveness of such modifications. The collected airborne radioactivity data will measure releases of airborne radioactivity to the environment and ensure that people living and working in the area are not exposed to radiation above regulatory limits. The air monitoring program is described in more detail in the FSP.

Task 5 - Data Validation

Data will be validated at each step of collection, reduction, and reporting. This will include validation of the following:

- Laboratory validation of data will follow standard operating procedures. Laboratory validation of data will consist of monitoring the variations in the accuracy and precision of routine analytical procedures through the use of recovery values and blanks.
- Field data validation will follow standardized data collection procedures, including calibration procedures will be used. Each person assigned to each data collection task is responsible for understanding and employing the

standard procedures to be used. Field data collected will be recorded on appropriate data collection forms or a field notebook.

- Laboratory data received from the analytical and soil laboratories will be reviewed by the project manager for obvious discrepancies. The data validation process will include an assessment of holding-time compliance, laboratory instrument tuning and performance, calibration procedures, results of calibration, and results of equipment, travel, and method blanks.

- Calculations include data manipulations made that can be checked and that are made in conjunction with the analysis or interpretation of data, engineering design, cost estimate, or any other related activity. Calculations will be reviewed according to the applicable procedures in this document.

- Upon receipt of data reports from the laboratories, data will be reviewed for obvious discrepancies. After screening, the data will be entered into the appropriate database. After data entry, the entries will be printed and checked against the original data. Errors will be corrected and the corrections verified by checking against the original data.

Further details on data validations tasks and procedures are included in Element D1 of this QAPP.

Task 6 - Quality Assurance Assessments

Quality Assurance Assessments will be conducted of the field survey data through sampling and laboratory analysis of soils. Sampling will include both soil with high field readings indicating radiologic impacts well above the clean-up criteria, and soil with low field readings indicating material below the clean-up criteria. Samples will be taken of the highest material encountered in each inclusion zone on a daily basis. Samples will also be taken on a daily basis of soil indicating level below the clean-up criteria. These analyses will be run at the field laboratory.

Quality assurance assessment of the field laboratory will be done periodically through the analysis at a second laboratory of the soil samples analyzed at the field laboratory. Those analyses will be run at either the USEPA subcontract laboratory, Argonne National

Laboratory, or at one of the subcontract laboratories for STS, which include Severn Trent of St. Louis, Missouri, or RSSI of Morton Grove, Illinois.

Internal and external performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FSP and the QAPP. Internal audits of field activities (sampling and measurements) will be conducted by the TRS Project Quality Assurance Supervisor. The audits will include, but not be limited to, examination of field sampling records, field instrument operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain-of-custody, etc. External audits may be conducted by personnel from the USEPA Region 5 Air and Radiation Division with assistance from USEPA's National Air and Radiation Environmental Laboratory and/or USEPA's Environmental Monitoring Systems Laboratory.

The internal performance and system audits of the laboratories will be conducted by a qualified STS auditor. The system audits, which will be done annually, will include examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedure, sample preparation and analysis, instrument operating records, etc. External performance and system audits of the laboratories may also be conducted by USEPA Region 5 Air and Radiation Division personnel.

Further details on the planned QA assessments are contained in Element C1 of this QAPP.

Task 7 - Data Usability Assessment

Data, which has been validated in accordance with the procedures in Task 5 above, will be reviewed and reconciled with the Project Data Quality Objectives. Specifically, this review will assess the ability to document that the clean-up criteria are being met for material remaining on site, the measurements and documentation are adequate for the material being shipped off site, and health and safety measurements are within data quality limits for all personnel potentially exposed to radiologically impacted materials. Further details on the data usability assessment are contained in Element D3 for this QAPP.

Field data will be assessed by the STS Project Manager or her designee. She will review the field results for compliance with the established QC criteria that are specified in the QAPP and FSP. Laboratory results will be assessed for compliance with required accuracy and completeness as follows:

- Accuracy of laboratory results will be assessed for compliance with the established QC criteria that are described in Element C1 of this QAPP.
- Data completeness of laboratory analysis results will be assessed for compliance with the amount of data required for decision making. The completeness is calculated using the following equation:

$$\text{Completeness (\%)} = \frac{\text{Valid Data Obtained}}{\text{Total Data Planned}} \times 100$$

- Data will be validated at each step of collection, reduction, and reporting.

The proposed QA system employs corrective and preventive action to correct and eliminate root causes of problems which are systemic and/or repetitive, or which could occur at a future time. Corrective action is necessary to remedy nonconformities that occur in the QA System. Corrective action includes:

- Identification of observed nonconformances in supplied product, services, operations, or output product
- Investigation of the discrepancy
- Determination of the cause

- Initiation of actions to correct the nonconformance to a degree appropriate to the magnitude of problems and commensurate with the risks encountered

- Evaluation of the effectiveness of the corrective action in preventing recurrence

- Changing the system and system documentation when necessary

Task 8 - Project Documentation

Field notebooks, field reports, sample data logs, soils radioactivity data, sample data analyses, progress reports, audits reports, quality control reports, equipment maintenance reports, health physics data, civil construction and excavation data, material transport records, chain of custody records, verification sampling, and closure documents will be generated for the removal actions at the GMO site. Given the relatively short anticipated duration of the excavation activities for this project, data can be effectively managed utilizing the paper records required in the Removal Action Work Plan.

An on-site field laboratory will be used to analyze soil samples as excavation and removal proceeds, and for pre-verification sampling that the clean-up criteria have been met. Analytical records will be kept at the site and at the Vernon Hills, Illinois offices of TRS's contractor, STS Consultants, Ltd. Air monitoring analyses will be maintained at both the site and STS's offices, and will be transmitted with the weekly progress reports to USEPA.

B. <u>Project Schedule</u>

The Project Schedule (Figure 3-2) shows the projected start and completion dates for project activities. The project's completion within the constraints of this schedule is dependent upon the weather factors cited below, the timely approval of the Removal Action Work Plan by USEPA, and the timely receipt of any required permits.

Constraints on unloading frozen soils at Envirocare indicate that it will generally not be feasible to excavate in cold weather. The freezing of soils in the shipping containers and the general prospects for inclement weather would seriously affect soil-handling operations at the Site. As a result, the schedule proper completion of excavation and transport to Envirocare by late fall 2001.

QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA ELEMENT A7

The overall QA objective is to meet and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results that accurately depict the quantities being measured. Specific procedures for sampling, chain-of-custody, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, corrective action, types of quality control checks required (reference samples, controls, blanks, interlaboratory comparison), the frequency of each check, and the quality control acceptance criteria for these checks are described in other sections of this QAPP. Radionuclide analyses of soils by gamma spectroscopy is not amenable to sample surrogate spikes. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability.

A. Data Quality Objectives (DQOs) Process

Step 1: Stating the problem

There are three phases of work that comprise this Work Plan. These consist of the Investigation and Delineation Phase, the Initial Contaminant Removal Phase, and the Site-wide Excavation, Monitoring and Removal Phase. The Investigation and Delineation Phase was begun with the survey and sampling work previously completed by Koh and Associates, as reported in their May 2000 report. This survey and sampling included walkover gamma scans on all accessible portions of the parking lot and soil samples obtained from 33 borehole locations. Thorium concentrations at 7 locations were found to exceed the NRC release limit (see Figure 1).

This phase will continue with the site surveys to be conducted as the asphalt pavement is removed. The Initial Contaminant Removal Phase will consist of the removal of the radiologically impacted zones identified in Phase 1. Finally, the Site-wide Excavation, Monitoring and Removal Phase will involve the surveying of all fill soils on site, and the segregation and removal for disposal of all radiologically impacted soils encountered.

Given the site's manufacturing history, some of the radiologically-impacted soils might also be contaminated with hazardous wastes. Radiologically-impacted soils will be sampled and waste characterization analyses performed to determine the appropriate disposal method.

Step 2. Identifying the Decision

The Decision Statement is: "Determine whether soils, in addition to those areas already identified as radiologically-impacted, need to be removed to clear the site of all radiologically impacted soils. Determine whether the known radiologically impacted soils in the previously identified contaminated zones also contain hazardous wastes."

Step 3: Identifying Inputs to the Decision

Inputs to the decision will include previous sampling efforts and previously established regulatory thresholds for adjacent properties. The Koh and Associates May 2000 Report presents survey and sampling results from the site. The survey and sampling included walkover gamma scans on all accessible portions of the parking lot and soil samples obtained from 33 borehole locations. Thorium concentrations at 7 locations were found to exceed the NRC release limit. Once the radiologically impacted soils have been removed from these known locations, all remaining fill soils on the site will be sampled in 18-inch lifts.

USEPA has previously established the baseline cleanup threshold of 7.1 pCi/g total radium (Ra-226 + Ra-228) for other sites covered by the UAO. This is the proposed threshold level for this Site also.

Step 4: Defining the Boundaries of the Study

The boundaries for the Study are property line, up to but not including the sidewalks. The scale of decision making is the entire site, including the surface soils and subsurface fill down to native soils and/or sand. The temporal boundaries of the Study are sampling during temperate weather. Excessive rain and subfreezing temperatures will halt the sampling and cleanup activities. No additional constraints to data collection exist.

Step 5: Developing a Decision Rule

The decision rule is "if elevated gamma readings are detected (above 7.1pCi/g) total radium (Ra-226 + Ra-228) during the survey of 100% of the soil surface, that soil will be removed in 18-inch lifts until such time as no elevated readings are detected, and the underlying soil is verified as clear of radiological impacts by USEPA."

The decision rule for the waste characterization is "for those soils with radiological impact in excess of the threshold level, if any hazardous chemicals are detected in concentrations above the regulated allowable limit, they will be separated and disposed of separately from the soils with only radiological impacts."

Step 6: Specifying Limits on Decision Error

Given the level of readings encountered in the Koh study, the removal action will commence with the areas of known radiological impact. After removal of these known soils, all remaining soil will be sampled. Since all soil on the site will be sampled, and verification sampling will be performed on the entire site, the probability of a decision error occurring which results in radiologically-impacted soils being left on the site is less than one percent. Decision errors for the laboratory analyses are part of the laboratory's SOPs and Method Procedures.

Step 7: Optimizing the Design

The first phase of sampling on the site was completed in the Koh study, which resulted in mapped locations of known radiological impact. In addition to these known areas of impact, upon removal of the existing asphalt the entire site will be measured for radiological impact exceeding the threshold amount, using a 5 x 5 grid and complete sampling of the intergrid areas. Sampling of all soil and the verification sampling of the remaining underlying soil is viable, when considering the known levels of contaminants and the temporal constraints. Verification sampling will be performed for the entire site once all the fill soils have been sampled for radiological impact and separated for disposal of the radiologically impacted soils.

B. Measurement Performance Criteria

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols. Accuracy is a measure of the nearness of a measurement to the true value of the quantity being measured.

Precision is a measure of the closeness to each other of repeated measurements of the same quantity. Duplicate (laboratory split) samples are considered to represent the same population if analyzed values are within two standard deviations of the population mean. That is:

$$A \pm a\sigma - B \pm b\sigma = 0$$

for some value of "a" and "b" when "a" and "b" range from 0 to 2.

The sensitivities required for radionuclide analyses will be the U.S. Nuclear Regulatory Commission (USNRC) Regulatory Guide 4.14.

Accuracy is defined as the extent of agreement between sample results and the true value of the parameter being tested, in this case, the level of radiological contamination. Laboratory control samples will be used to evaluate sample accuracy, using spiked samples. The accuracy of the spiked sample is measured by the percent recovery of the analyte. The spike recovery is calculated as follows:

$$\%\ \text{Recovery Accuracy} = \frac{\text{Spiked Sample Conc.} - \text{Unspiked Sample Conc.} \times 100}{\text{Spiked Concentration Added}}$$

The SOPs for the field radionuclide screening are outlined in Document 210 of Appendix B. Accuracy and precision requirements for field screening analyses are included in Table 7-2. Sensitivity requirements of equipment are specified in the SOP describing the equipment. The laboratory's sensitivity for Ra-226 and Ra-228 is summarized on Table 7-3. Tables 7-4 and 7-5 show the minimum detectable limits for Total Solid Particulates (TSP) by Th-Alpha (gross alpha) and the minimum detectable activity for TSP by gamma spectroscopy and the minimum detectable levels for gross alpha and gamma spectroscopy, respectively.

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under normal conditions. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{Completeness (\%)} = \frac{\text{number of valid data}}{\text{number of samples collected for each parameter analyzed}} \times 100$$

Data generated by the laboratory has a completeness target of 90 percent.

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of site conditions. The rationale of the sampling network is discussed in detail in the FSP. Representativeness will be satisfied by assuring that the FSP is followed, proper sampling technique are used, proper analytical procedure are followed and holding times of the samples are not exceeded in the laboratory. Representativeness will be assessed by the analysis of duplicate (laboratory split) samples.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPP, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and QA objectives.

Table 7-1
Summary of Sample Collection and Analysis [(a)]

Purpose	Sample Method	Ra-226 and Ra-228 Analysis	Alpha	Duplicate (Field Split) Samples
Air Monitoring	High-Volume Air Monitoring Station	(b) (c)	(b)	0
Verification Sampling	Soil Sampling	(d)	-	6 sub-samples per set

(a) Does not include field QC samples.
(b) A minimum of one sample collected from four separate air monitoring locations per 8 hour period (one day of operation) for the site. Filters will be changed daily. TSP analysis procedures are described in Section 5.3 of the Air Monitoring SOP-212.
(c) Air samples will be tested for gross alpha.
(d) Verification sampling frequency defined in Verification Sampling Plan (Appendix 5 of the Remediation Work Plan).

Table 7-2

Radiological Laboratory QA Objectives

Purpose	Method	Accuracy	Precision	Completeness
Ra-226 and Ra-228	NaI Gamma Spectroscopy	±I- 2σ	±I- 2σ	90
Ra-226 and Ra-228	HpGe Gamma Spectroscopy	±I- 2σ	±I- 2σ	90

Table 7-3
Minimum Detectable Activity for the On-Site Laboratory Soil Counter
by Gamma Spectroscopy

Counting Time	Ra-226, pCi/g	Ra-228, pCi/g
2-Minutes	1.40 ± 0.60	1.30 ± 0.56
5-Minutes	0.93 ± 0.40	0.83 ± 0.36
10-Minutes	0.67 ± 0.29	0.62 ± 0.27
20-Minutes	0.61 ± 0.26	0.55 ± 0.24

The onsite laboratory conditions are:

- 20 gram soil placed in a 20-ml polyethylene liquid scintillation counting vial
- Sample counted in a Packard Minaxi system (NaI (Tl) well-type gamma detector)

- Date processed using NUTRANL software. The standard deviation includes the compounded errors of the analysis
- Minimum Detectable Activity per USNRC Regulatory Guide 4.14 (at 4.65 times the standard deviation of the analysis for the instrument background).

Table 7-4
Minimum Detectable Limits for Th-Alpha (Gross-Alpha)
By TSP (Total Solid Particulates)

Air Sample Type	Run Time (mins)	Flow Rate (L/min)	Volume (cc)	Alpha BKGD (counts/min)	Alpha MDA [(a)] (dpm)	Alpha MDA (μCi/cc)	Th-232 MDA [(b)] (μCi/cc)
Craseby GMW-2000	10080	1416	1.4E+10	0.3	0.5	4.7E-17	9.4E-18
SAIC AVS- 80A	1440	169.9	2.4E+08	0.3	0.5	2.7E-15	5.4E-16
SAIC AVS- 60A*	480	198.2	9.5E+07	0.3	0.5	7.0E-15	1.4E-15
Eberline RAS-1	480	45	2.2E+07	0.3	0.5	3.1E-14	6.2E-15

Air Sample Type	Run Time (mins)	Flow Rate (L/min)	Volume (cc)	Alpha BKGD (counts/min)	Alpha MDA (dpm)	Alpha MDA (μCi/cc)	Th-232 MDA[(b)] (μCi/cc)
MSA Flow-Lite	2400	2	4.8E+06	0.4	0.6	1.6E-13	3.2E-14

(a) MDA calculated per USNRC Regulatory Guideline 4.14 assuming samples counted on a gas flow proportional counter with an efficiency of 34.1 % and a count time of 30 minutes.

(b) The Th-232 decay series contains seven alpha-emitting nuclides: Th-232, Th-228, Ra-224, Rn-220, Po-216, Bi-212, and Po-212. Of these, the first three nuclides can be assumed to be in complete equilibrium. The noble gas Rn-220 (thoron) may be ejected from the original matrix by recoil from the alpha particle decay of Ra-224. The fraction of Rn-220 that is removed via emanation is dependent on several variables, and is assumed to range from 10 to 40%. The emanating fraction is assumed to be transported away from the original matrix. If 40% of the Rn-220 escapes, the activity of the Rn-220 and its three alpha-emitting progeny nuclides will be at 60% of the Th-232 activity. These four alpha-emitting nuclides produce a total of 3.35 alpha emissions per Rn-220 decay. Since the Rn-220 activity is 60% of the Th-232 activity, these four nuclides only emit the equivalent of two alpha particles per Th-232 decay. These two alphas when combined with the three alpha particles from the nuclides in full equilibrium with the parent, result in the total emission of the five alpha particles. Thus, the Th-232 contribution will be one-fifth or 20% of the total alpha activity.

Table 7-5
Minimum Detectable Activities for Gamma Spectroscopy

Nuclide	MDA, uCi	TSP Volume, ml	MDA, uCilml
Pb-210	4.0E-05	9.5E+07	4.2E-13
Pb-212	2.0E-06	9.5E+07	2.1 E-14
Pb-214	3.7E-06	9.5E+07	3.9E-14
Bi-212	3.0E-05	9.5E+07	3.2E-13
Bi-214	4.4E-06	9.5E+07	4.6E-14
Ac-228	1.1 E-05	9.5E+07	1.2E-13
Th-234	1.1 E-05	9.5E+07	1.2E-13
Pa-234m	8.6E-04	9.5E+07	9.1 E-12

SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

ELEMENT A8

Radiation field surveys will be conducted by health physics technicians experienced and trained in the use of the instruments. Radiation survey work will be conducted under the supervision of a certified health physicist, and reviewed by the Project Coordinator and STS Project Manager.

The field laboratory will be operated by a health physics technician trained in the operation of the NUTRANL software and detector equipment. The alpha counter will also be operated by an experienced health physics technician. All NUTRANL and alpha counter data will be reviewed by the health physics supervisor.

Site and project specific radiation and health and safety training will be provided for all on-site personnel prior to work on-site. All personnel required to work in the Contamination Reduction Zone or the Exclusion Zone shall complete training conforming to the requirements of 29 CFR 1910.120(e). Field personnel shall complete radiation safety training in compliance with 32 IAC 400. Training will be conducted by a qualified safety specialist and/or a qualified senior health physics technician, at a minimum. The Project Training Plan is included in Attachment 7 to the Work Plan.

DOCUMENTATION AND RECORDS
ELEMENT A9

A. Documents and Records Generated

The following types of data will be generated during the project:

- Surface gamma survey records
- Soil sampling records
- Soil sample field laboratory data
- Fixed laboratory soil analyses data (USEPA contract and STS subcontract laboratories)
- Air quality sampling records
- Air quality analytical data

Surface Gamma Survey Records - These records will be kept on the attached forms (Figure A-9.1). A copy will be maintained in the field office and the original filed in the STS Vernon Hills, Illinois office. Survey equipment calibration records (daily equipment check records) will be maintained in the field office files.

Soil Sampling Records - These records will be documented in three places. A bound field log book will be maintained by each person conducting field sampling. The pages will be sequentially numbered. Records will include the sampler's name, date, sample number, sample location including site grid and depth, gamma readings, climate and any unusual conditions. The soil sampling records will include a chain of custody (Figure A-9.2). Each sample container will be uniquely identified on the chain of custody. The soil sampling records include the individual sample containers. Each container will have the unique sample number, date, sampler's name or initials, sample time, and project name (GMO) on the sample label.

Soil Sample Field Laboratory Data - These data will be provided in two forms. The initial NUTRANL data set will consist of one set per sample and will include the radionuclide concentrations and error limits for uranium 238, thorium 232, radium 226, and potassium 40; the sample number; date and time sampled; laboratory number (sequential); identify the analyst; and analytic method (NUTRANL).

The second field laboratory data form will be a consolidated spreadsheet with all analysis in sequence by laboratory number. This table will include the sample number, data and time sampled, radionuclide concentrations and error limits for the four NUTRANL analytes, and a line totaling the thorium and radium concentrations. The field laboratory will also maintain a copy of the chain of custody for those samples received and analyzed.

Fixed Laboratory Soil Analyses Data - Records for the fixed laboratories, either the USEPA contract laboratory at Argonne or the STS subcontract laboratories, Severn Trent and/or RSSI, will include chain of custody copies, sample receipt and tracking forms, preparation and analysis logbooks, raw data forms, tabulated data summaries, calibration records, and standards, QC sample results, and any corrective action reports.

Air Quality Sampling Records - These records will include duration of sampling including precise start and stop times, date, location on the site parameter, flow rate, sampling equipment, sampler's initials, climate, and any unusual conditions of the sampled interval or vicinity. For PAM samples, the personnel will be identified and the location(s) worked, in addition to start/stop times, data, flow rate, equipment, climate and any unusual conditions.

Air Quality Sample Results - Data will include a unique sequential laboratory number, the chain of custody, sample identifier (either location or personnel), time and date, one day alpha count and a 4-day alpha count.

B. Data Reporting Package Format and Documentation Control

Data will be recorded in field logbooks according to the procedures in the Field Logbook SOP, 215. As noted in SOP-215, logs for each day will contain, at a minimum,

- Personnel on site (including contractors, visitors and regulators, as applicable)
- Weather
- Equipment used and calibration
- Sketch of applicable work area
- Work summary.

The Project QA Supervisor will perform audits of the field notebooks periodically during the project. The Project Manager or her designee will also review the logbooks prior to submitting monthly reports to EPA. These management audits and QA reports will be submitted to EPA at the end of the Project, as outlined in C1. The Project Manager is responsible for assuring adherence to data quality objectives concerning data reporting and data management.

All waste characterization laboratory analysis performed by STL will follow STL's Data Review and Verification SOP (STL-QA-0011). In addition, data reporting requirements for specific analyses are found in the following SOPs:

- Extraction and Cleanup of Organic Compounds from Waters and Soils, CORP-OP-0001STL
- Toxicity Characteristic Leaching Procedure and Synthetic Precipitation Leaching Procedure, CORP-OP-0002STL
- Gas Chromatographic Analysis Based on Method 8000B, 8021B, 8081A, 8082 and 8151A, SW-846, CORP-GC-0001STL

- GC/MS Analysis Based on Methods 8270C and 625, CORP-MS-0001STL
- Determination of Volatile Organics by GC/MS Based on Method 8260B, 624 and 524.2, CORP-MS-0002STL
- Acid Digestion of Soils, SW846 Method 3050B, CORP-IP-0002STL
- Reactive Cyanide, STL-IP-0001
- Reactive Sulfide, STL-IP-0002
- IDL/MDL Determination, STL-QA-0016
- Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy (Method 3010A), STL-IP-0013
- Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analyses, SW-846 Method 6010B and EPA Method 200.7, CORP-MT-0001STL
- Preparation and Analysis of Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW846 7470A and MCAWW245.1, CORP-MR-0005STL
- Preparation and Analysis of Mercury in Solid Samples by Cold Vapor Atomic Absorption Spectroscopy, SW846 7471A and MCAWW 245.5, CORP-MT-0007STL
- Cyanide Analysis by the Technicon Traacs 800 Autoanalyzer, STL-WC-0002
- Analysis of pH in Water, STL-WC-0011
- Analysis of Sulfide in Water, STL-WC-0012
- Analysis of pH in Soil, STL-WC-0021
- Flash Point by Pensky-Martens Closed Cup Tester, STL-WC-0026
- Paint Filter Liquids Test, STL-WC-0031
- Preparation of Samples for Gamma Spectroscopy, STL-RC-0025
- Daily Operations of a Germanium Spectroscopy System, STL-RD-0101

C. Data Reporting Package Archiving and Retrieval

STS will store all project records at its Vernon Hills office until directed by EPA to dispose of the records. TRS and the EPA will have access to the data. Any other access will be allowed only after clearance from both TRS and the EPA.

SAMPLING PROCESS DESIGN

ELEMENT B1

The sampling system has been previously described. The project schedule is presented in Element A6, and the sampling design rationale is presented in Element A7.

SAMPLING METHODS REQUIREMENTS

ELEMENT B2

The details of the field sampling procedures for the radiological samples are described in FSP.

In addition to the radiological soil samples, soil sampling will include the following parameters for the Waste Characterization Samples.

Ignitability	Flash Point
Corrosivity	pH
Reactivity	unstable, reacts violently with water, is sufficiently cyanide or sulfide bearing the produce toxic gas, or is capable of detonation.
Toxicity	TCLP analysis for regulated contaminants

Groundwater sampling will consist of the following parameters for the groundwater discharge samples, for discharge to the Chicago city sewers.

Waste or Chemical	Concentration (mg/L)
Cadmium	0.11
Chromium (total)	2.77
Copper	2.07
Cyanide (total)	1.20
Fats, Oils and Greases (FOG) (total)	250.0
Iron	250.0

Lead	0.5
Mercury	0.0005
Nickel	3.98
Zinc	2.61
Dichloromethane	0.294
Chloroform	0.309
1,1,1-Trichloroethane	0.193
Trichloroethylene	0.242
Benzene	0.278
Tetrachloroethene	0.225
Toluene	0.247
Ethylbenzene	0.329
Volatile Organic Compounds (total)*	0.567
Total Toxic Organics**	2.13

pH Range - Not lower than 5.0 or greater than 10.0

Temperatures of liquids or vapors at point of entrance to the sewerage system shall not exceed 150°F.

* Total Volatile Organic Compounds shall be the arithmetic sum of the concentrations of:

dichloromethane
chloroform
1,1,1-trichloroethane
trichloroethylene
benzene
tetrachloroethene
toluene
ethylbenzene
acrolein
acrylonitrile
1,3-butadiene
carbon tetrachloride
chlorobenzene
dichloroethane
dichlorobenzene
1-ethyl 2-methylbenzene
napthalene
styrene
1,3,5-trimethylbenzene
vinyl chloride
xylenes
1,4-dioxane

ethylene dibromide
methyl ethyl ketone

** Total Toxic Organics shall be the arithmetic sum of the concentrations of those pollutants found under Title 40 Part 413.02(i) of the Code of Federal Regulations.

Field sampling procedures for these non-radiological samples are included in the FSP.

SAMPLE HANDLING AND CUSTODY REQUIREMENTS
ELEMENT B3

It is the USEPA and Region 5 policy to follow the USEPA Region 5 sample custody, or chain-of-custody protocols as described in "NEIC Policies and Procedures," EPA-330/9-78DD1-R, revised June 1985. This custody is divided into three parts: Sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area.

A. Field Activity and Sampling Documentation

Field Logbooks will be used to document all sampling activities. Chain of Custody forms shall be completed for all samples (air, soil, and waters). The following information shall be included in the field logbook regarding samples and may be cross referenced with the Chain of Custody Form:

Soil and Water:

- Initial of Technician collecting the sample
- Time and date of sample collection
- Location where sample obtained using appropriated sample grid notations
- Depth where soil sample was obtained
- Count rate (cpm) at the location where sample was obtained

- Unique sample number
- Additional applicable comments pertaining to description of sample matrix, weather, or other factors that may affect sample analysis

Air:

- Initial of Technician collecting the sample
- Time and date of sample collection
- Start and Stop time of air sampler (used to calculate volume)
- Starting and ending flow rate of air sampler
- Location or air sampling station
- Unique sample number

B. Sample Labeling

All samples shall be labeled with the above information and placed into a plastic bag for transfer to the field laboratory. Samples are typically batched in groups depending on their purpose or location (e.g. QC, blanks, close-out, screening).

The technician shall ensure that the information on the sample container is also transferred to the Chicago of Custody Form (See Attachment 1). Prior to labeling the containers, the technician shall ensure that the exterior of the sample container is free from loose soils and/or radioactive contamination. All SOPs still apply for samples leaving an Exclusion Zone. To ensure that all information is retained and verifiable, all applicable information shall also be recorded in the field logbook. Once the sample is transferred to the Field Laboratory it shall be assigned a unique sample number in sequential order.

All samples shall be labeled using permanent ink. No whiteout or erasures are allowed. Any entry that is to be deleted will use a single crossout that is signed and dated.

C. Transfer of Samples

Samples shall be collected and transferred to the field laboratory only by trained and authorized Health Physics personnel. Proper Chain of custody shall be demonstrated by documenting that the sample is always in the possession of an authorized person and under custody. Custody is considered to be in someone's direct possession and/or view, or secured in a locked are under the person's control. Each sample custodian shall sign off on the Chain of Custody form (signature, time and date) for each transfer.

D. Laboratory Custody Procedures

When the samples are received in the laboratory, proper Chain of Custody shall be maintained. Samples shall be logged and assigned a laboratory sample number as soon as they are received. The laboratory technician shall sign the Chain of Custody form in the presence of the Transferor. From this point on the samples shall be considered to be in the custody of the field laboratory supervisor. The laboratory sample number shall be recorded on both the Chain of Custody Form and on the sample container label. This sample number will be assigned in a sequential format that allows each sample to be identified in a unique fashion.

A duplicate copy of the Chain of Custody form shall be placed into a binder when received. The original Chain of Custody form shall stay with the samples until they are placed in the final evidence file.

After all required analyses are performed the samples shall be held in a locked storage with limited access. All samples and analyses data shall be maintained until the appropriate regulatory agency approves disposal. Data from analysis shall be maintained in both a hard copy file as well as a backed up computer format.

E. Outside Laboratory Custody Procedures

In the event that samples need to be transferred from the Field Laboratory to another party, they shall be packaged in accordance with Department of Transportation regulations. Sample coolers shall have all necessary packing material to ensure that no leakage occurs. Un addition, a custody seal shall be placed on the cooler opening to identify unauthorized opening or tampering. Sample containers being shipped to outside parties will also be affixed with seals to identify tampering. Samples not being shipped to outside parties will not need to be sealed, as they are still under direct custody. Air bills used by the shipping company along with a duplicate copy of the Chain of Custody form shall be placed on file as documentation of custody.

F. Final Evidence Files

Upon project completion the following documents will be placed into the final evidence file:

- Chain of Custody forms
- Data from sample analysis
- Any applicable air bills
- Detailed description of final sample disposition. Samples shall be maintained until approval is received to dispose of them or return them to the waste generator
- Field logbooks from all applicable personnel

The final evidence file shall be held at the following address in a secure location:

Stan A. Huber Consultants, Inc.
200 North Cedar Road
New Lenox, Illinois 60451

The file custodian shall be Glenn A. Huber

As required by Section V.5 of the UAO, Kerr-McGee, TRS and all their contractors and agents will preserve all documentation for a minimum of six years following completion of the removal action. The content of the evidence file will include all relevant records, reports, correspondence, logs, field logbooks, laboratory sample preparation and analysis logbooks, data packages, pictures, subcontractor's reports, chain-of-custody records/forms, data review reports, etc. The evidence file will be in the custody of the TRS's Project Manager, and kept in a secured area.

ANALYTICAL METHODS REQUIREMENTS
ELEMENT B4

Radium analysis (Ra-226 and Ra-228) will be conducted on soil samples. Analysis will be through gamma spectroscopy at fixed laboratory facilities (Severn Trent Laboratory and Argonne National Laboratory) and through NUTRANL at the field laboratory.

Severn Trent Laboratory
13715 Rider Trail North
Earth City, Missouri 63045-1205

Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439-4836

341 East Ohio Street
Chicago, Illinois 60611

Waste characterization analysis (RCRA Characteristic Hazardous Waste) will be conducted on soil samples. Analysis will be in accordance with methods per SW-846.

Groundwater analysis (MWRDGC Environmental Remediation Wastewater Ordinance May, 9, 1996, Appendix A) will be conducted on water samples. Analysis will be in accordance with methods in SW-846.

SOPs for the laboratory analysis are attached, Appendix B.

QUALITY CONTROL REQUIREMENTS
ELEMENT B5

A. Field Sampling Quality Control

Assessment of field sampling precision for the radiological verification sampling will be made through collection of replicate subsamples from the verification sample area. Six subsamples will be obtained by splitting one sample in the field. Each subsample will be analyzed separately in the field laboratory. The subsamples will be composited to develop a single sample for analysis by USEPA's contract laboratory at Argonne National Laboratory (Argonne).

Satisfactory precision will be met if the mean of the six subsamples is within 50% (relative percent difference (RPD)) of the result of the Argonne analytical result. Counting statistics for low activity samples will provide for RPD to increase to 100% for samples where all analysis are below the clean-up criteria of 7.1 pCi/g total radium.

QC procedures for field measurements are limited to checking the reproducibility of the measurement by obtaining multiple readings on a single sample or standard and by calibrating the instruments. Gamma radiological survey QC is described in Appendix B.

Two types of QA will be used by the laboratory to ensure the production of analytical data of known and documented usable quality. These types are QA program and QC checks.

B. Analytical Quality Control Checks

The Severn Trent laboratory has a written QA/QC program which provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory.

The stated objectives of the laboratory QA/QC program are to:

- Ensure that all procedures are documented, including any changes in administrative and/or technical procedures
- Ensure that all analytical procedures are conducted according to sound scientific principles and have been validated
- Monitor the performance of the laboratory by a systematic inspection program and provide for a corrective action as necessary
- Collaborate with other laboratories in establishing quality levels, as appropriate
- Ensure that all data are properly recorded and archived

All laboratory procedures are documented in writing as either SOPs or Method Procedures. Internal QC procedures for analytical services will be conducted in accordance with standard operating procedures and the individual method requirements.

The specifications include the types of QC checks required (reference samples, controls, blanks, interlaboratory comparison), the frequency of each check, and the quality control acceptance criteria for these checks.

The laboratory will document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in non-conformance with the QC criteria will be re-analyzed by the laboratory, if sufficient sample volume is available. It is expected that a sufficient volume of soil will be collected for re-analyses.

INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS
ELEMENT B6

As part of the FSP and the Health and Safety Plan, routine maintenance procedures for equipments used in the field in defined by both action and frequency. Both of these documents are included in the Remediation Work Plan.

As part of the QA/QC program, a routine preventative maintenance program is conducted by the laboratory to minimize instrument failure and other system malfunctions. The laboratory performs routine scheduled maintenance, and repairs or coordinates with the vendor for the repair of all instruments. All laboratory instruments are maintained in accordance with manufacturer's specifications and the requirements of the specific method employed. This maintenance is carried out on a regular, scheduled basis, and is documented in the laboratory instrument logbook for each instrument. Emergency repair or scheduled manufacturer's maintenance is provided by factory representatives. The laboratory SOPs are included in Appendix B.

INSTRUMENT CALIBRATION AND FREQUENCY
ELEMENT B7

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment that are used for conducting tests and laboratory analyses. These instruments and equipment should be calibrated prior to each use or on a scheduled, periodic basis.

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

Equipment to be used during the sampling will be examined to certify that it is in good operating condition. This includes ensuring that all maintenance requirements are being observed. Notes from previous sampling trips will be reviewed so that any prior equipment problem is not overlooked, and all necessary repairs to equipment have been completed.

Calibration of instruments is governed by the specific SOP for the applicable analysis method, and such procedures take precedence over the following general discussion. All survey instruments used during the excavation and restoration activities shall be calibrated semiannually or when maintenance is required that could affect the calibration. Counters used for air samples shall be checked before use or daily, using calibrated reference sources. Vendor calibration procedures shall be in accordance with the American National Standards Institute (ANSI) N323-1978 and calibration shall be traceable to the National Institute of Standards and Technology (NIST).

Alpha counters use an ionizable gas to detect alpha radiation. The instrument measures alpha and beta/gamma present on filter paper. This instrument is checked daily using a reference source. The calibration procedure is described in the attached SOPs. Air pumps used to collect air monitoring samples will be calibrated daily.

Calibration of laboratory equipment will be based on approved written procedures. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed and will be subject to QA audit. Calibration and record management procedures are presented in the applicable REF SOPs.

INSPECTION/ACCEPTANCE OF REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

ELEMENT B8

Details of the procedures that will be used to ensure supply cleanliness and reagent purity are described in the FSP (Appendix 9 of the Removal Action Work Plan) and the attached SOPs in Appendix B. The inspection/acceptance requirements for consumables and supplies that will be used in the field and laboratory are detailed in SOP-LLII345, Surveys for Contamination and Release of Equipment for Unrestricted Use and in the documented SOPs and Method Procedures for the laboratories.

DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

ELEMENT B9

The following reports of previous environmental investigations were provided by TRS for the preparation of the Remediation Work Plan.

- Letter dated August 22, 1990 from OHM Corporation to GMO Limited Partnership
- Environmental Site Assessment dated August 28, 1990 prepared by Professional Service Industries, Inc.
- Visual Site Inspection dated December 30, 1993 prepared by USEPA, Region 5, with attached Preliminary Assessment/Visual Site Inspection Report dated December 16, 1993 prepared by PRC Environmental Management, Inc.
- Preliminary Environmental Review dated March 8, 2000, prepared by GaiaTech, Inc.
- A Phase II Soil and Groundwater Investigation Report Time-Life Property, Grand Avenue and McClurg Court, Chicago, Illinois, dated May 11, 2000, prepared by GaiaTech, Inc.
- Summary of Radiological Survey Time-Life Property, Chicago, Illinois, dated May 2000, prepared by B. Koh & Associates, Inc.

- Scanner Van Survey of the Chicago Illinois Streeterville area dated July 12, 2000 prepared by USEPA Radiation and Indoor Environments National Laboratory.

The delineation of the radiologically impacted materials was initiated through an investigation completed by B. Koh and Associates, Inc. as documented in their May 2000 report listed above. The delineation will be further developed in the initial stages of pavement removal and ground survey, as described in Section 4 of the Removal Work Plan.

INSTRUCTIONS FOR DATA MANAGEMENT

ELEMENT B10

A. Data Recording

Two types of data will be collected: Field laboratory analysis using NUTRANL software and gamma spec detectors; and field survey gamma radiation data.

NUTRANL analysis reports are printed directly, one for each sample. A copy is attached.

The detector is calibrated daily. Calibration records are maintained at the field laboratory. Calibration forms are attached.

The Data Quality/Records Manager will review the results. Comparison with field survey data will provide a means of identifying errors. Calibration data will be reviewed weekly.

The field gamma surveys consist of manually collected data as the excavation proceeds. A sample data form is attached. Validation occurs as the soil is resurveyed at 18-inch intervals during excavation. When contamination is detected an exclusion zone is established and closure verification procedures are required.

Closure verification consists of a pre-verification survey when all identified impacted soil is removed. No documents are generated for that survey. A sample is collected, transmitted under chain-of-custody (copy attached) to the field laboratory, and analyzed by NUTRANL. Upon demonstration of the pre-verification sample passing the cleanup criteria, USEPA mobilizes staff to the site, conducts a walkover survey with no written documentation, and collects a set of six sub-samples for every 100 m^2 area to be verified as clean. Those samples are transferred under chain-of-custody to the field laboratory and analyzed by NUTRANL. Upon receipt of results showing the area meets clean closure standards, the results and a Notification of Successful Verification Survey Form is transmitted to USEPA On-Scene Coordinator for signing. A copy of a notification form is attached.

The verification samples are subsequently forwarded under chain-of-custody to USEPA's contract laboratory, Argonne National Laboratory. Reports of that analysis are not provided to be included in the documents generated for this investigation.

B. Data Validation

Data validation of the NUTRANL analysis is provided by comparison of six replicate analysis of subsamples for each verification analysis. Additionally, those data of the samples are provided to USEPA, with the samples reanalyzed at Argonne. The six replicate analysis and the field data from the closure verification surveys are compared to identify anomalous data.

C. Data Transformation/Data Reduction

A transformation is to be used for converting the measured radionuclides activity to the cleanup standard activity. NUTRANL will measure the following:

Uranium 238 (U-238)
Thorium 232 (Th-232)

Radium 226 (Ra-226)

Potassium 40 (K-40)

The cleanup criterion is 7.1 picocuries per gram (pCi/g) total radium, Ra-226 plus Ra-228. Radium 228 will be measured using thorium 232 as a surrogate.

The total radium activity will be calculated as follows:

Ra-226 + Th-232 = Total Radium

All data transformation calculations will be checked by the Data Quality/Records Manager.

D. Data Transmittal/Transfer

Two principal data transmittals will occur during the project: transfer of data from the field laboratory to the project team; and from the project team to USEPA.

Transfer of field laboratory data to the project team will include the following:

1. Field laboratory personnel will make a xerographic copy of the NUTRANL report and file sequentially by sample number.
2. A copy will be transmitted by facsimile to STS's offices in Vernon Hills, Illinois, to the attention of the Project Manager, Julie Apolinario.
3. The original will be hand delivered to the Data Quality/Records Manager at the project field office.

The field laboratory will also generate data regarding air quality monitoring. Those data will be provided directly from the laboratory in the same fashion as the NUTRANL data.

1. A xerographic copy will be made and filed sequentially by sample number.

2. A copy will be transmitted by facsimile to the STS Vernon Hills, Illinois, office to the attention of the Project Manager, Julie Apolinario.

3. The original will be hand delivered to the Data Quality/Records Manager at the field office.

These air quality data will be transmitted by the Project Manager to USEPA on a weekly basis with the weekly status report. That report and accompanying data will be transmitted by facsimile.

The verification analytical data for the six subsamples from each area to be closed will be transmitted by facsimile to USEPA with the Notification of Successful Verification forms upon receipt of complying data. The signed forms are returned by facsimile from USEPA and copies are kept at the field office and at the STS Vernon Hills, Illinois office.

E. Data Analysis/Data Assessment

The data analysis and data assessment will consist of a pass-fail comparison to the cleanup criteria of 7.1 pCi/g total radium. There is no modeling involved. There are no secondary data manipulations involved. All computer data storage will be commercially available spreadsheets (Microsoft Excel) with no manipulation or calculation of the data other than as described above under Data Transformation.

F. Data Tracking

Data will be tracked by geographic grid designation. As a location is identified as thorium-impacted, the following steps will track the data and clean closure.

1. The impacted zone will be marked by rad rope (braided magenta and yellow) as an exclusion zone.

2. The coordinates of the exclusion zone will be marked on a daily report form (copy attached).

3. The exclusion zone(s) will be plotted on a site map daily. This site map will be maintained by the Field Team Leader and Data Quality/Records Manager. An updated copy (xerographic copy) will be couriered to the STS Vernon Hills, Illinois office weekly.

4. The Data Quality/Records Manager, or in his/her absence, the Field Team Leader, will confirm data verification analysis have been received, and Notification of Successful Verification form sent to and returned from USEPA before exclusion zone(s) are backfilled.

5. The field map of exclusion zone(s) will be marked in color to designate identified exclusion zone(s) (perimeter marked in red), and a verified clean exclusion zone(s) (interior shaded in green). The updated map will be copied (xerographic) and provided by courier weekly to the STS Vernon Hills, Illinois office.

6. The Data Quality/Records Manager will be the person responsible for data tracking and to confirm all appropriate data is received and stored at the field office and the STS Vernon Hills, Illinois office.

G. Data Storage/Retrieval/Security

Data will be stored in three locations in addition to whatever storage of transmitted data is provided by USEPA. At the project site, data will be initially stored by the field laboratory subcontractor. That storage will be both an electronic archive on the computer hard drive, and in a hard copy printout filed sequentially by sample number. That location will be in a basement office in the Time-Life building adjacent to the project site and will be maintained for the duration of the fieldwork. Upon demobilization, that data will be transferred to the contractor's office in New Lenox, Illinois, and retained for one year.

The second location is in the STS field office at the project site. That data set will be maintained by the Data Quality/Records Manager. That location will be either in a construction-type trailer or a basement office in the Time-Life building. The data will be maintained at that location until completion of the fieldwork and notification from USEPA that all impacted soil has been removed from the site. Upon demobilization, the data files will be transferred to the STS Vernon Hills, Illinois office to be incorporated in the project files and archived for permanent storage.

The third location will be at the STS Vernon Hills, Illinois office. Copies transmitted to the Project Manager will be stored at this location until the field files are received following completion of the fieldwork. At that time, redundant files will be discarded and the permanent files placed in the STS project archives.

STS provides for off-site secure storage of electronic copies of project files. These will include data received by facsimile or email, and electronic tables or text generated for the project documentation. STS also provides for off-site secure storage of hard copies of project files following copying on microfilm after a period of on-site storage of approximately seven years.

The field laboratory space will be in secure, locked offices in the Time-Life building. The daily transmittal of data and weekly updates of site maps to the STS Vernon Hills, Illinois office provides for security with regards to the field office files.

ASSESSMENT AND RESPONSE ACTIONS

ELEMENT C1

Assessment

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FSP and QAPP. The audits of field and laboratory activities may include two separate, independent parts: internal and external audits. This QAPP provides procedures for those audits that will be conducted by TRS and its contractors.

Two types of QA will be used by the laboratory to ensure the production of analytical data of known and documented usable quality. These types are QA program and QC checks.

The stated objectives of the laboratory QA/QC program are to:

- Ensure that all procedures are documented, including any changes in administrative and/or technical procedures;
- Ensure that all analytical procedures are conducted according to sound scientific principles and have been validated;
- Monitor the performance of the laboratory by a systematic inspection program and provide for a corrective action as necessary;
- Collaborate with other laboratories in establishing quality levels, as appropriate; and
- Ensure that all data are properly recorded and archived.

All laboratory procedures are documented in writing as either SOPs or Method Procedures. Internal QC procedures for analytical services will be conducted in accordance with standard operating procedures and the individual method requirements.

The specifications include the types of QC checks required (reference samples, controls, blanks, interlaboratory comparison), the frequency of each check, and the quality control acceptance criteria for these checks.

The laboratory will document in each data package provided that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in non-conformance with the QC criteria will be re-analyzed by the laboratory, if sufficient sample volume is available. It is expected that a sufficient volume of soil will be collected for re-analyses.

External performance and system audits of the laboratories selected for the project for approval/disapproval may be conducted by personnel from the USEPA Region 5 Air and Radiation Division with assistance from USEPA's National Air and Radiation Environmental Laboratory and/or USEPA's Environmental Monitoring Systems Laboratory. USEPA Region 5 Superfund FSS has the discretion to audit the waste characterization laboratory and these audits may or may not be announced.

Field Audits

Internal audits of field activities (sampling and measurements) will be conducted by the TRS Project Quality Assurance Supervisor. The audits will include, but not be limited to, examination of field sampling records, field instrument operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain-of-custody, etc.

A field audit will take place to determine that personnel are executing required project activities and to verify that all established procedures are being followed. Follow-up audits will be conducted to correct deficiencies and to verify that QA procedures are maintained throughout the excavation and restoration activities. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation.

External audits may be conducted by personnel from the USEPA Region 5 Air and Radiation Division with assistance from USEPA's National Air and Radiation Environmental Laboratory and/or USEPA's Environmental Monitoring Systems Laboratory.

Laboratory Audits

The internal performance and system audits of the laboratory(ies) will be conducted by a qualified STS auditor. The system audits, which will be done annually, will include examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedure, sample preparation and analysis, instrument operating records, etc.

External performance and system audits of the laboratories selected for the project for approval/disapproval may be conducted by personnel from the USEPA Region 5 Air and Radiation Division with assistance from USEPA's National Air and Radiation Environmental Laboratory and/or USEPA's Environmental Monitoring Systems Laboratory.

Reports

The auditor will prepare a report describing the audit findings. The auditor will review the report with the laboratory and the Project Manager, and provide a copy of the audit to the person responsible for that activity. Copies also will be submitted to the Project Manager and placed in the project quality assurance file.

The responsible party will respond to the audit findings, describing the cause of the finding, the remedy to be implemented to cure the deficiency, the actions to be taken to prevent the reoccurrence of the defect, and the schedule to address these actions.

When the indicated corrective actions have been completed, the responsible party will notify the auditor. When all findings have been addressed, the auditor will prepare a closing report documenting that the audit findings have been resolved, and that the audit has been closed. This report will be submitted to the Project Manager and placed in the project quality assurance file.

Response Actions

STS's QA system employs corrective and preventive action to correct and eliminate root causes of problems which are systemic and/or repetitive, or which could occur at a future time. When solutions require changes to the quality system and its documentation, those changes are recorded and captured within the document control system.

Corrective Action

Corrective action is necessary to remedy nonconformities that occur in the QA System. Nonconformities can be reported by the customer, by any supplier or by a contractor. Corrective action includes:

- Identification of observed nonconformances in supplied product, services, operations, or output product;
- Investigation of the discrepancy;
- Determination of the cause;
- Initiation of actions to correct the nonconformance to a degree appropriate to the magnitude of problems and commensurate with the risks encountered;

- Evaluation of the effectiveness of the corrective action in preventing recurrence; and

- Changing the system and system documentation when necessary.

Responsibility for corrective action is determined organizationally by the area affected. The Project Manager or designee approves all corrective action and periodically reviews corrective action to verify effectiveness. Corrective action involving a supplier or contractor requires that supplier or contractor to provide the following information:

- Description of factors contributing to the deficiency

- Description of the remedy to correct the nonconformance

Conditions adverse to quality, safety, reliability, or performance are documented and reported to appropriate management for corrective action.

Preventive Action

Where corrective action is necessary to eliminate a nonconformance or correct a deficiency within the quality assurance system, preventive action is taken to discover and eliminate potential nonconformance. Preventive action includes:

- Periodically reviewing work operations, audit results, quality records, service reports, and customer complaints to detect and eliminate potential causes of nonconformities

- Discovery and evaluation of alternative solutions to prevent nonconformance to a level corresponding to the risks encountered

- Implementation of an appropriate solution alternative

- Evaluation of the effectiveness of the preventive action to prevent recurrence

- Changing the system and system documentation when necessary

- Assuring that Management reviews all preventive actions

- Establishing procedures to assure that the preventive action process occurs continually

Responsibility for preventive action is the same as for corrective action discussed above.

Sample Collection/Field Measurements

All project personnel will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document to the Project Manager or designee. The Project Manager will be responsible for assessing the suspected problems. The assessment will be based upon the potential for the situation to impact the quality of the product. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the Field Team Leader.

The Project Manager will be responsible for ensuring that corrective action for nonconformances are initiated by:

- Evaluating all reported nonconformances
- Controlling additional work on nonconforming items
- Determining disposition or action to be taken
- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective actions taken
- Ensuring nonconformance reports are included in the final site documentation in project files

If appropriate, the Project Manager will ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

When it becomes necessary to modify a program, the responsible person notifies the Project Manager of the anticipated change and implements the necessary changes after obtaining the approval of the Project Manager. The change in the program will be documented on the field change request that will be signed by the initiators and the Field Team Leader. The field change request for each document will be numbered serially as required. The field change request shall be attached to the file copy of the affected document. The Project Manager must approve the change in writing or verbally prior to field implementation, if feasible. If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and action taken.

The Project Manager for the Site is responsible for controlling, tracking, and implementation of the identified changes. Reports on all changes will be prepared by the Project Manager and distributed to all affected parties that include the USEPA OSC. The USEPA OSC will be notified whenever program changes in the field are made.

Laboratory Corrective Action

Implementation of corrective actions for the laboratory will be the responsibility of the laboratory personnel.

REPORTS TO MANAGEMENT
ELEMENT C2

In addition to the audit reports submitted to the Project Manager in accordance with QAPP Element C1, a report summarizing QA activities and issues will be included with the final Excavation Closure Report. This report will be an attachment to the final Excavation Closure Report and will contain QA sections that summarize data quality information collected during the project.

The QA activities report in the final Excavation Closure Report will be a written report produced by STS and will contain the following information:

- Changes in QAPP
- Summary of QA/QC programs, training and accomplishments
- Results of technical systems and performance evaluation audits
- Significant QA/QC problems, recommended solutions, and results of corrective actions
- Data quality assessment in terms of precision, accuracy, representativeness, completeness, comparability, and method detection limit
- Indication of whether the QA objectives were met
- Limitations on use of the measurement data

DATA REVIEW, VALIDATION AND VERIFICATION REQUIREMENTS

ELEMENT D1

Data review, validation and verification requirements are presented in Elements B1, B2, B3, B4, B5 and B7. The Project QA Supervisor is responsible for validation of the laboratory data, as outlined in the Project Management Section. No deviations from the procedures presented in these Elements is anticipated.

DATA REDUCTION, VALIDATION, AND REPORTING PROCEDURE

ELEMENT D2

PURPOSE

The purpose of this procedure is to present protocol for data reduction, validation, and reporting. The procedure includes data listing and tables, validation for field and laboratory data, calculations, and statistical analyses.

SCOPE

This procedure applies to field and laboratory data generated at the Site.

REFERENCES

STS Consultants, Ltd. Quality Assurance Manual

EQUIPMENT AND MATERIALS

Chain-of-Custody Sheet

INSTRUCTIONS

Data Reduction Schemes

Data reduction schemes will be used to structure, analyze, simplify, and present collected data. These procedures assure a systematic approach to data reduction and analysis. Procedures to be used to manage these data are:

- Listing of data;
- Summary statistical tables; and
- Data simplification.

Listing Data

Data, as originally recorded in the field at the time of sampling or as reported and verified by the analytical or testing laboratory, are to be compiled in sampling reports for each sampling event or period. These data are to include the information pertaining to QC (e.g., field blanks, split samples). Laboratory reports are to indicate that the laboratory has performed and reported standard control procedures (e.g., duplicates, recovery analyses) and should include the data that were used to determine the method detection limit.

Data will be listed in an orderly and logical format. A computerized database system may be used. Accuracy of data lists and computerized databases, if used, are to be verified by treating the tabulations and entries as calculations.

Summary of Statistical Tables

Where appropriate for reporting purposes, data may be summarized and presented in tabular form. Appropriate summary statistics would be calculated and presented in a summary table. These statistics may include:

- total number of values
- mean
- median
- standard deviation
- minimum value
- maximum value
- minimum detectable activity concentration

Other statistics may be included in data summaries where appropriate.

The listing of data will be combined with the statistical summary. Sample sizes, ranges, and minimum and maximum values allow evaluation of spatial and temporal changes in parameter values. Statistical summaries will be developed as calculations are subjected to the requirements of the calculation procedures included in this document.

Data Simplification

Data simplification will be used as a tool for data reports. Data simplification is the presentation of data using ranking procedures. Rankings can be performed using mean, median, maximum, or minimum values. Rankings can be developed based on the information that the analyst wishes to convey. This procedure often is complimentary to graphical displays of data.

Validation Criteria

Data will be validated at each step of collection, reduction, and reporting using procedures summarized below.

Laboratory Validation

Laboratory validation of data will follow standard operating procedures specified in the laboratory QA plan. Data that do not meet validation criteria will be identified by the laboratory when the data report is issued.

Laboratory validation of data will consist of monitoring the variations in the accuracy and precision of routine analytical procedures through the use of surrogate recoveries, certified check standards, and instrument blanks. QC sample recoveries must fall within the upper and lower control limits for each control parameter. Instrument blanks are used to determine the method detection limit per NRC regulatory Guide 4.14. Calculations will be checked using the procedures in this document.

Field Data

As specified in this document, standardized data collection procedures, including calibration procedures will be used. Each person assigned to each data collection task is responsible for understanding and employing the standard procedures to be used. Field data collected will be recorded on appropriate data collection forms or a field logbook.

The Quality Assurance Supervisor will review representative data collection forms to confirm that proper data forms are used, that required information is recorded, and that calibrated equipment is used where appropriate.

Receipt of Laboratory Data

Data received from analytical and soil laboratories will be reviewed by the laboratory supervisor(s) for obvious discrepancies. The laboratory generating analytical data for this project will be required to submit results that are supported by sufficient backup and

QA/QC data to enable the reviewer to determine conclusively the quality of the data. Validity of laboratory data will be determined based on the precision and accuracy of the objectives presented in this document. The data validation process also will include an assessment of holding-time compliance, laboratory instrument performance, calibration procedures, results of calibration, and results of instrument and method blanks. Upon completion of the review, the laboratory will be responsible for developing a QA/QC report for each analytical data package. All data will be stored and maintained according to the standard procedure of the laboratory QA plan. Where test data have been reduced, the reduction method will be described in the report provided by the laboratory or will reference the applicable section of the laboratory QA plan.

Laboratory data will be reported in the measurement units indicated in the analytical procedures. For tasks for which measurement units have not yet been determined, laboratory data will be reported in the measurement units specified in the appropriate work plan. Issuance of a laboratory report will indicate that requisite calculations specified in the laboratory QA plan have been completed and validated.

Where applicable, outlier treatments and statistical and trend analysis may be applied to the data for validation purposes. Verification criteria for these methods are described in this procedure.

Calculations

Calculations include data manipulations that can be checked and that are made in conjunction with the analysis or interpretation of data, engineering design, cost estimate, or any other related activity. Calculations include: solution of mathematical equations; preparation of input and checking of output of computer models; drawings of cross-sections, isopachs, contour maps; and other geologic, hydrologic, and engineering interpretations. Calculations also include any process or reasoning used to develop a conclusion used or expressed in a report. Calculations will be reviewed according to the applicable procedures in this document.

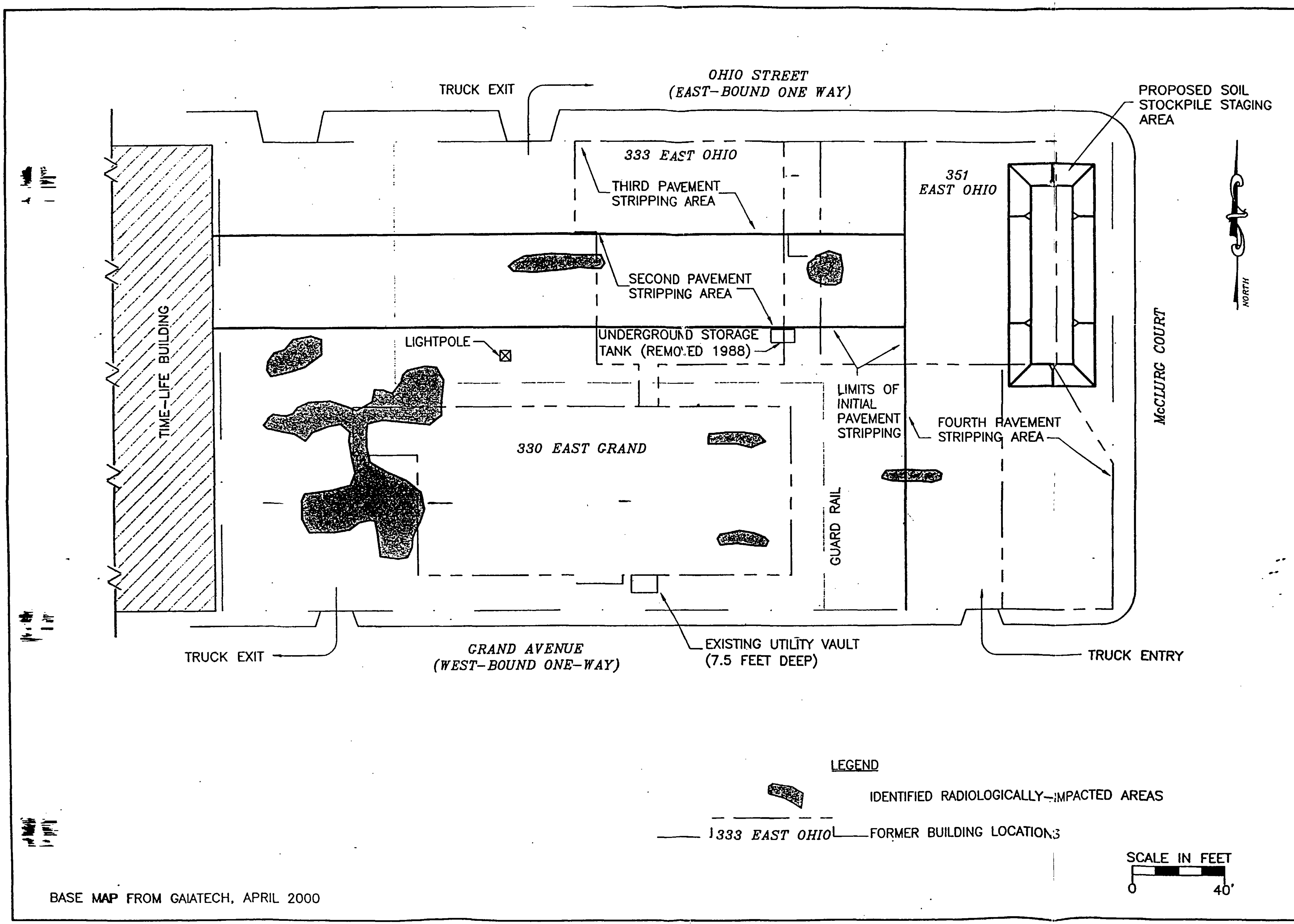
Database Entries

Upon receipt of data reports from the laboratories, data will be reviewed for obvious discrepancies. After screening, the data will be entered into the appropriate database. After data entry, the entries will be printed and checked against the original data. Errors will be corrected and the corrections verified by checking against the original data.

USABILITY/RECONCILIATION WITH DATA QUALITY OBJECTIVES
ELEMENT D3

Element A7 describes data reconciliation with data quality objectives. Element C1 describes assessment and response actions to be put in place when data do not meet the project quality objectives.

FIGURES



DRAWN BY	BWS	DATE	5-1-01
CHECKED BY	MKK	DATE	5-1-01
APPROVED BY	RGB	DATE	5-1-01
CADFILE	X:\PROJECTS\25585-XG\01-LOC-DIAG.dwg		

PAVEMENT STRIPPING, SOIL STAGING,
ANTICIPATED TRAFFIC PATTERNS
GMO SITE
CHICAGO, ILLINOIS

STS Consultants Ltd
Consulting Engineers

STS PROJECT NO. 25585-XG

STS PROJECT FILE 01-LOC-DIAG.dwg

SCALE 1"=40'±

FIGURE NO. 3-1

SECTION 1

ATTACHMENT 1

PROJECT MANAGEMENT ORGANIZATION CHART

PROJECT MANAGEMENT ORGANIZATION CHART

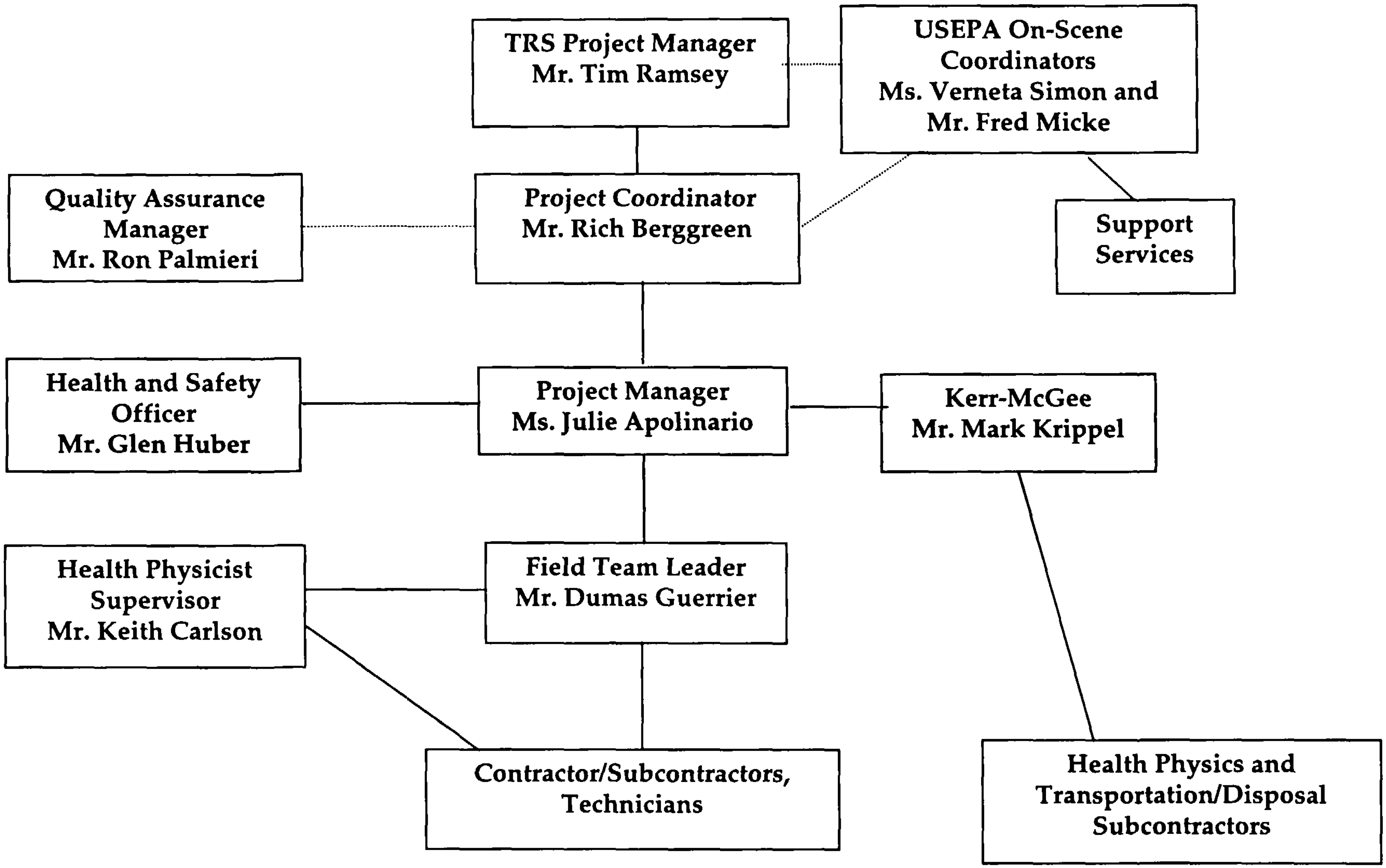


Figure 2-1

SECTION 2

ATTACHMENT 2

CHAIN OF CUSTODY FORM
STAN A. HUBER CONSULTANTS, INC.

sonci

CHAIN OF CUSTODY

Stan A. Huber Consultants, Inc.
200 N. Cedar Rd.
New Lenox, IL 60451
(815) 485-6161
Fax (815) 485-4433

Results To:
Company STS Consultants, Inc.
Name Rich Berggreen
Address 750 Corporate Woods Pkwy.
City Vernon Hills ST IL Zip 60061
Phone (847) 279-2572 Fax

Bill To:
Company STS Consultants, Inc.
Name Rich Berggreen
Address 750 Corporate Woods Pkwy.
City Vernon Hills ST IL Zip 60061

Company STS Consultants, Inc.
Client Contact Rich Berggreen
Address 750 Corporate Woods Pkwy.
City Vernon Hills ST IL Zip 60061
Phone (847) 279-2572 Fax

P. O. #
Project #
Project ID: **Grand Pier/North Columbus**

Analysis Ordered

Sample I.D. Location	Sample Type	Container Size	Container Type	Container Number	Sampling Date	Sampling Time	Lab I.D.	NUTRANL					Comments/Description
	Soil	20 ml	Plastic Vial										

Chain-of-Possession

Relinqushed By:	Received By:	Date/Time	Relinquished By:	Received By:	Date/Time
Relinqushed By:	Received By:	Date/Time	Relinquished By:	Received By:	Date/Time
Relinqushed By:	Received By:	Date/Time	Relinquished By:	Received By:	Date/Time

SECTION 3

ATTACHMENT 3

CHAIN OF CUSTODY FORM
QUANTERRA

Quanterra®

FIGURE 8.5-1
Example Quanterra® Chain-of-Custody Form

Reference Document No. ________
Page 1 of ________

Project Name/No.: ________
Sample Team Members: ________
Profit Center No.: ________
Project Manager: ________
Purchase Order No.: ________
Required Report Date: ________

Sample Shipment Date: ________
Lab Destination: ________
Lab Contact: ________
Project Contact/Phone: ________
Carrier/Waybill No.: ________

Bill To: ________
Report To: ________

ONE CONTAINER PER LINE

Sample Number	Sample Description/Type	Date/Time Collected	Container Type	Sample Volume	Preservative	Requested Testing Program	Condition on Receipt	Disposal Record No.

Special Instructions:

Possible Hazard Identification:
Non-hazard ❑ Flammable ❑ Skin Irritant ❑ Poison B ❑ Unknown ❑

Sample Disposal:
Return to Client ❑ Disposal by Lab ❑ Archive ____ (mos.)

Turnaround Time Required:
Normal ❑ Rush ❑

QC Level:

1. Relinquished by: *(Signature/Affiliation)* Date: ____ Time: ____
1. Received by: *(Signature/Affiliation)* Date: ____ Time: ____

2. Relinquished by: *(Signature/Affiliation)* Date: ____ Time: ____
2. Received by: *(Signature/Affiliation)* Date: ____ Time: ____

3. Relinquished by: *(Signature/Affiliation)* Date: ____ Time: ____
3. Received by: *(Signature/Affiliation)* Date: ____ Time: ____

Comments:

SECTION 4

ATTACHMENT 4

CHAIN OF CUSTODY FORM - GRACE ANALYTICAL LAB, INC.

GRACE ANALYTICAL LAB, INC.

HONE (708) 449-9449 • FAX (708) 449-3663
300-B McDermott Drive • Berkeley, IL 60163

CHAIN OF CUSTODY PAGE ______ OF ______

TURNAROUND

Date Required:
Schedule in advance to insure RUSH Processing

Comments / Special Instructions

CLIENT INFORMATION

Project Manager:
Company:

Phone: Fax:
Project Name:
Project ID#:
Sampler:

SAMPLE RECEIVING RECORDS

Samples Received "On Ice" ☐ YES ☐ NO
Sample Temperature(If not "On Ice") ______c
Samples Intact/Not Leaking ☐ YES ☐ NO

SAMPLE CHARACTERISTICS

☐ NONHAZARDOUS
☐ Special Handling Required (Please Describe)

QC Levels
___ None
___ Level 2
___ Level 3
___ Level 4

[redacted]	FIELD ID, LOCATION / DESCRIPTION	DATE	TIME	MATRIX	Number of Containers	PRESERVATIVE		ANALYSIS NEEDED							REMARKS

MATRIX: Soil (S), Surface Water (SW), Ground Water (GW), Waste Water (WW), Waste/Solid (W/S), Waste/Liquid (W/L), Drinking Water (DW), Air Cassettes (AC); Note if COMPOSITE (C) or GRAB (G)
PRESERVATIVE: Nitric Acid (HNO_3), Hydrochloric Acid (HCl), Sodium Hydroxide (NaOH), Sulfuric Acid (H_2SO_4), Sodium Bisulfate ($NaHSO_4$), Methanol(CH_3OH), None

Relinquished By (Signature):	Date/Time:	Received By (Signature):	Date/Time:	Relinquished By (Signature):	Date/Time:	Received For Lab By (Signature):	Date/Time:
Relinquished By (Signature):	Date/Time	Received By (Signature):	Date/Time	Relinquished By (Signature):	Date/Time	Received For Lab By (Signature):	Date/Time

WHITE - ORIGINAL FILE COPY

SECTION 5

ATTACHMENT 5

NUTRANL LABORATORY REPORT

U-238	-.08	+/-	1.31
TH-232	.34	+/-	.36
RA-226	1.73	+/-	.61
K-40	22.83	+/-	11.61

S2618
K-(-8)-8'
10/31/00 13:08
[redacted]
NUTRANL RESULTS

SECTION 6

ATTACHMENT 6

NUTRANL DAILY CALIBRATION FORM

Day-of-Use Constancy Record
Accuspec Gamma Counter – NUTRANL Analysis

For the Month of: ____________________

Standard Used: ____
Manufacturer Model Serial # Isotope Date Activity

Mean counts source standard: __________ σ: ____________

Mean counts background (empty vial): __________ σ: ____________

From χ^2 Test performed on: performed by:

Acceptable Range = 95.5% Confidence Interval $= x \pm 2\sigma$

Source Standard Range: __________ to _____________
Background Range: __________ to _____________

Date	Standard Count (5 min)	Background Count (5 min)	Within Acceptable Range Y or N?	Performed By:

This data was reviewed and approved by _________________ on____________
as being complete and correct.

Review Notes:____

Continue on back of page if needed.

SECTION 7

ATTACHMENT 7

FIELD GAMMA SURVEY FORM

Project # __________ Project Name __________________ Sheet _____ of _____

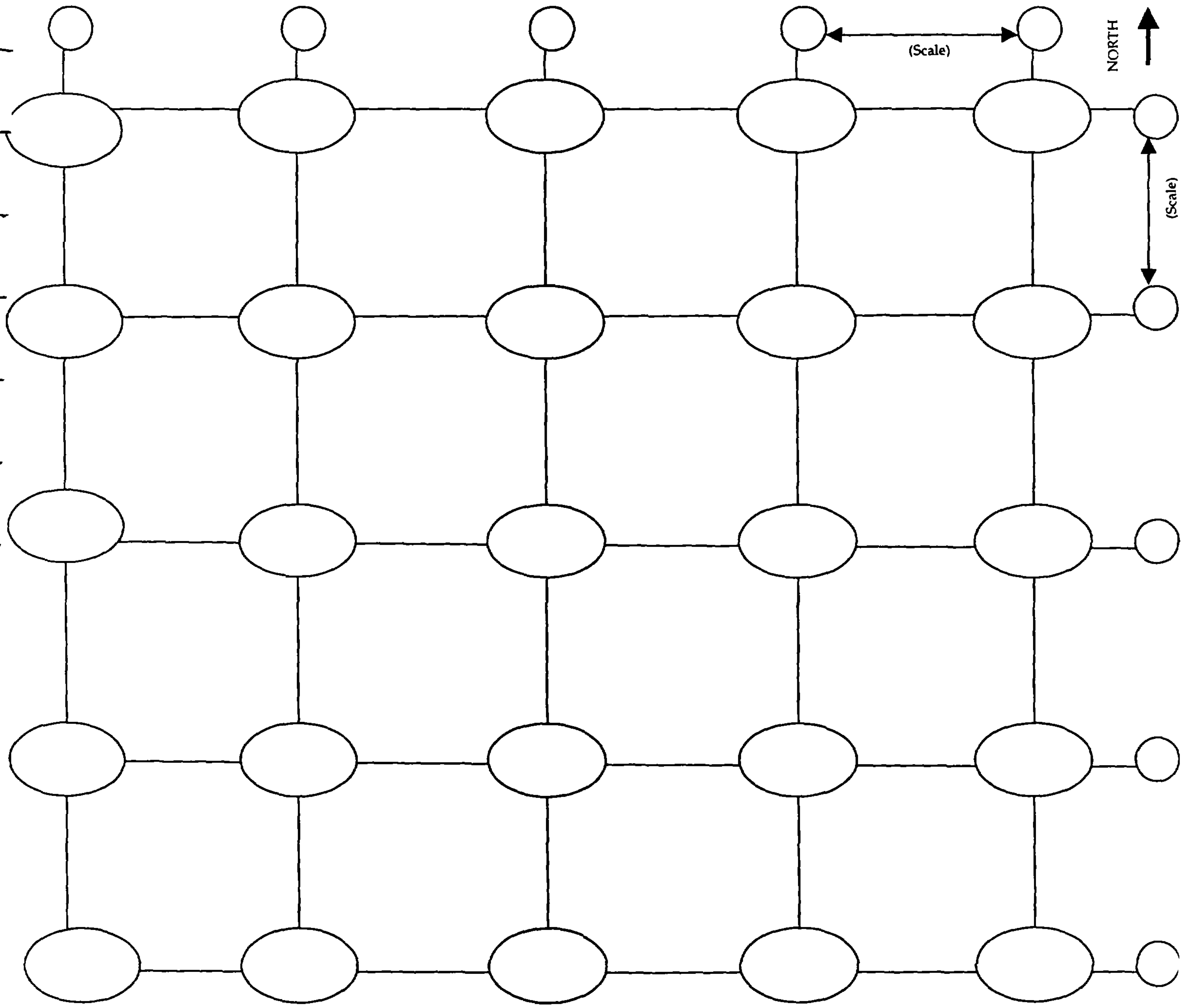
STS Consultants, Ltd.

Date ____________________________ Technician ________________________

Inst. Model ________________________ Serial No. _________________________

Inst. Calibrated (Y/N)? ______________ Lift Elevation______________________

Write grid designations in circles. Indicate excavated area with heavy line. Record counts at intersections in CPM. Indicate areas with audible alarms by shading the area.



SECTION 8

ATTACHMENT 8

CHAIN OF CUSTODY FORM
STS CONSULTANTS, LTD.

CHAIN OF CUSTODY RECORD

№ 38939

STS

RECORD NUMBER ______ THROUGH ______

Contact Person ______
Phone No. ______ Office ______
Project No. ______ PO No. ______
Project Name ______

Special Handling Request

☐ Rush
☐ Verbal
☐ Other

Laboratory ______
Contact Person ______
Phone No. ______
Results Due ______

Sample I.D.	Date	Time	Grab	Composite	No. of Containers	Sample Type (Water, soil, air, sludge, etc.)	Preservation Y	Preservation N	Field Data PID/FID Ambient	Field Data PID/FID Sample	Field Data PH	Field Data Special Cond.	Analysis Request	Comments on Sample (Include Major Contaminants)

Collected by:	Date	Time	Delivery by:	Date	Time
Received by:	Date	Time	Relinquished by:	Date	Time
Received by:	Date	Time	Relinquished by:	Date	Time
Received by:	Date	Time	Relinquished by:	Date	Time
Received for lab by:	Date	Time	Relinquished by:	Date	Time

Laboratory Comments Only: Seals Intact Upon Receipt? ☐ Yes ☐ No ☐ N/A

Final Disposition:

Comments (Weather Conditions, Precautions, Hazards):

Distribution: Original and Green - Laboratory Yellow - As needed Pink - Transporter Goldenrod - STS Project File
Instructions to Laboratory: Forward completed original to STS with analytical results. Retain green copy.

6/99cp10k

STS Consultants Ltd.
Consulting Engineers

SECTION 9

ATTACHMENT 9

NOTIFICATION OF SUCCESSFUL VERIFICATION SURVEY FORM

FORM 223-1
NOTIFICATION OF SUCCESSFUL VERIFICATION SURVEY

Area Identification: ______________________________

Date of Verification Survey: ______________________________

Time of Verification Survey ______________________________am/pm

The above-described excavation was surveyed at the time and date indicated above. The survey indicated that all soils have been removed as required by the Site Removal Action Criteria.

Documents pertaining to this survey are attached for review and approval by the U.S. EPA.

Signed:

______________________________ Date ________

______________________________ (Print Name)

______________________________ (Print Title)

For
STS

____

The attached Verification Survey documents were reviewed by U.S. EPA, Region V on ______________. The results of this survey indicate that the verification criteria as contained in the UAO, have been met.

Authorization is hereby granted to commence backfill and restoration work at this excavation.

Signed:

______________________________ Date ________

______________________________ (Print Name)

______________________________ (Print Title)

For U.S. EPA Region V

SECTION 10

ATTACHMENT 10

DAILY FIELD REPORT FORM

FIELD REPORT

Construction Technology Group

NOTE: The responsibilities and authority of STS and STS' Field Personnel include neither the responsibilities nor the authority of the "Competent Person" for the project site as defined by OSHA Regulations: 29CFR 1926 Subpart P.

Page _______ of _____

Project ______________________________ Project No.______________________

Location ______________________________ Day/Date______________________

Summary of technical and/or engineering services performed, including field test data. Locations, elevations and depth are estimated

* *Field Test Data is Estimated - Pending Final Laboratory Test Results*

Field Representative ______________________ By______________________

Position______________________ Title______________________

Company______________________ STS Consultants Ltd.

White - Office White - Field Yellow - Time Card

STS Consultants Ltd.
Consulting Engineers

STS Construction Technology Group

Field Location Diagram

Project ______________________________ STS Project No. ______________

Location ______________________________ Date ______________

APPENDIX A

341 EAST OHIO STREET SITE

POSITION DESCRIPTIONS

APPENDIX A

Title: Position Descriptions

Revision Number: 0

Date: Replaces: New

POSITION DESCRIPTIONS

The following details the duties for which each position will be responsible. Resumes for assigned personnel are attached.

PROJECT COORDINATOR

The Project Coordinator is Mr. Richard G. Berggreen, C.P.G.

Duties

Approve all external reports before their submission to the USEPA.

Develop mechanisms to review and evaluate task products with respect to planned requirements, work orders and authorizations. Major responsibilities will include performing reviews of checklists prepared by the Field Team Leader and the Project Manager and cross-checking to ensure all necessary permits and testing have been done and filed, reviewing daily reports, reviewing files to determine work is properly documented, and working with the Project Manager to negotiate changes to standard procedures.

Acquire and provide technical and corporate resources as needed to ensure performance within budget and schedule constraints.

Main point of contact with regulatory agencies and the public. Represent the project team at meetings and public hearings.

Be responsible for the preparation and quality of interim and final reports.

Duties

Coordination and management of field staff including surveying, excavating, sampling and restoration. Contact the Project Manager and the Project Coordinator if any changes to the approved work order or the specifications are necessary.

Preparation of the Work Order for Site, including: confirming estimates of extent of contamination; selecting, as necessary, locations for decontamination facilities, runoff controls, stockpile areas and staging areas (where equipment, materials, etc. will be put during the day or if left overnight); and determining starting points and direction(s) of excavation.

Provide day-to-day direction for the excavation and restoration work at the Site.

Work with the appropriate technical staff to determine if excavation has been properly completed.

Review test result sheets supplied by the laboratories, subcontractors, and construction personnel (such as the pre-verification radiological testing by the Radiological Technicians).

Work with the subcontractor's quality control testing personnel to ensure all required testing is properly done and documented, and review specifications as necessary prior to and during the work to ensure all work is properly done and documented.

Prepare daily construction reports describing the work completed, any testing, the results of monitoring at the Site, and any problems or unusual conditions which occurred and their resolution.

PROJECT QUALITY ASSURANCE SUPERVISOR

The Project Quality Assurance Supervisor is Mr. Richard G. Berggreen, C.P.G.

Duties

The principal responsibility of the Project Quality Assurance Supervisor is to implement and monitor compliance with established quality assurance program. This includes developing and supervising programs to implement quality assurance, to monitor the quality controls used for compliance with these programs, and to work with other project management personnel to identify and correct areas of non-compliance.

Quality Assurance implementation for the GMO Site project includes:

- developing and implementing a quality assurance program that governs quality controls application to project activities.
- developing audit, checklists, schedules, corrective actions tracking and other tools to summarize and manage the quality assurance and quality control requirements.
- developing, scheduling, and conducting training sessions to familiarize project personnel with applicable quality requirements.
- coordinate and scheduling a program of announced and unannounced audits of project activities and project records.
- conducting or leading announced and unannounced quality audits as required by the audit plan.
- assisting Project Management in identifying and resolving areas of non-compliance with the QAPP, the CQA Plan, or the Specifications.
- reporting the status of quality assurance and quality control compliance to Project Management Personnel according to the quality assurance implementation plan.
- reviewing submittals as requested by project management.
- making site visits and inspecting the construction site to review the work in progress, the completed work, and plans for future work.
- reviewing the test results supplied by the laboratories, subcontractors, and construction personnel to verify the completeness of the reports.

HEALTH AND SAFETY COORDINATOR

The Health and Safety Coordinator is Mr. Keith Carlson

Duties

Advises the Field Team Leader on all aspects of health and safety on site.

Administration of the Project Health and Safety Program.

Oversees or conducts periodic inspection of workers and work areas.

Plans and oversees or conducts site training/orientation and daily health and safety meetings.

Oversees or selects and periodically inspects protective clothing and equipment.

Oversees or conducts monitoring for on-site noise hazards and the use of hearing protection.

Approves storage and maintenance of protective clothing and equipment.

Oversees monitoring work parties for signs of stress, such as cold exposure, heat stress, and fatigue.

Oversees monitoring for on-site hazards and conditions.

Conducts periodic reviews to determine if the Site Health and Safety Plan is being followed.

AREAS OF SPECIALIZATION

- *Environmental Geology*

EDUCATION

M.S., Geology, San Diego State University, 1976

B.A., Geology, Occidental College, Los Angeles, 1971

Graduate Studies, Geology, UCLA

REGISTRATION

Registered Professional Geologist: Illinois, California, Kentucky

Certified Professional Geologist: Indiana

AFFILIATIONS

Association of Engineering Geologists

Sigma XI

Representative Experience

Principal Geologist in the Environmental Sciences Group. Responsible for environmental and hazardous waste evaluations including municipal and hazardous waste landfill investigations, soil and groundwater monitoring and remediation projects at industrial facilities, and remedial investigations at controlled and uncontrolled waste disposal sites. Previous experience includes 11 years with major engineering consulting firm.

Representative project experience includes the following:

- Managed Phase I and Phase II environmental assessments for property transfers or refinancing on commercial and industrial real estate nationwide, including properties in AR, AZ, CA, CO, CT, DE, FL, GA, HI, IL, IN, KS, LA, MD, ME, MA, MN, MI, MO, MS, NC, NM, NY, OH, OR, PA, TN, TX, UT, VA, WA, and WI.
- Principal in charge of assessment and closure of underground storage tanks (USTs) at more than 40 sites for an Illinois utility. Included supervision of tank removal contractor, field sampling, subcontractor laboratory logistics, closure report preparation, and application for leaking underground storage tank (LUST) Trust Fund reimbursement.
- Supervised groundwater exploration program and design of first site to qualify under Illinois LUST Trust fund. Included design of monitoring well system, recovery well and water treatment system.
- Project Manager and Principal in charge of removal, closure, and remediation of more than 100 UST sites including retail service stations removing and upgrading USTs; industrial sites involving hazardous materials above-ground storage tanks (ASTs) and USTs, fuel oil USTs and motor vehicle fuel USTs; warehouse and commercial facilities removing USTs; and USTs encountered in the course of site development which require removal and soil/groundwater remediation.
- Principal involved in removal and disposal of TCE-contaminated soil and sludge classified as a

Resource Conservation and Recovery Act (RCRA) hazardous waste from a mining equipment re-manufacturing facility in central Indiana.

- Managed preparation of geologic, hydrogeologic and geotechnical reports at operating hazardous waste and municipal waste co-disposal facilities in Cook and Will Counties for state permit applications and USEPA Part B permit applications. Supervised the field installation and sampling of monitor well networks at site expansions and proposed sites in northeastern Illinois.
- Principal overseeing exploration, design and installation of remediation system to address toluene and xylene contaminated groundwater from a paint solvent release. The remediation consists of soil vapor extraction and ground water pump and treat.
- Principal on assessment of extent, design and installation of remediation system for volatile organic compounds contamination at an underground storage tank facility at a chemical manufacturing plant in the Chicago area. System consists of soil vapor extraction water treatment and NPDES discharge permit.
- Principal in charge of soil and groundwater investigation of pharmaceutical chemical manufacturing plant involving more than 700 soil borings, 40 monitoring wells and hydrologic assessments in site conditions in response to an administrative consent order. Included management of STS and subcontract personnel, coordination with client representatives and meetings with state agency representatives.
- Project Manager on an evaluation of groundwater contamination at a creosote wood-treating plant in Illinois. Included computer modeling of groundwater migration, assessment of contaminant migration rates, both vertically and horizontally, and potential contaminant retardation due to organic carbon partitioning in the site soils.
- Prepared annual RCRA groundwater monitoring reports for several facilities including a lead processing plant hazardous waste landfill and a sulfuric acid disposal pond in Missouri.

- Project Manager on hydrogeologic and permitting studies for six wood-treating facilities throughout eastern United States. Included aquifer assessments through tracer studies and pump tests; contamination assessments of soils, groundwater and surface water; and remedial investigation/feasibility studies (RI/FS) programs to provide recommendations on-site remediation.

- Project Geologist on an evaluation of a hazardous waste site with potential leakage into a developed aquifer in south central Kansas. Participated in the assessment and remedial measures design and installation.

- Project Manager and coordinator of the preparation of land use and land cover maps for more than 400 square miles of densely developed Cook County, Illinois. The maps were prepared on the basis of aerial photographic interpretation, topographic map assessments, and correlation with Cook County zoning maps.

- Project Geologist on a U.S. Army Corps of Engineers project of safety inspections for more than 65 dams in southeastern Missouri. These dams included both earthen and mine tailings dams and all had been classified as high hazard dams. Responsibilities included coordination of scheduling, field support services, liaison with the Corps of Engineers, geologic field explorations and report preparation.

- Worked on fault studies for critical structures such as hospitals, dams and nuclear reactor foundations, feasibility studies for underground storage of compressed air, environmental impacts of the siting of a large missile complex, and siting studies for liquified natural gas import terminals. The fault studies involved aerial photograph analysis, field mapping, trench logging and petrographic analysis of fault zones in Washington State, central and southern California, Argentina and Mexico. Involved evaluation of such hazards as on-site faulting, coastal and fluvial erosion, and slope stability. Participated in extensive aerial photograph reconnaissance in southeastern Alaska to evaluate fault potential for the Alaska-Canada pipeline.

- Project Manager on an evaluation of construction

Publications

"Old Contamination, New Regulations, Close Cooperation, and Recent Remediation at a Chicago Lumberyard Brownfield Success," Proceedings of the TAPPI International Environmental Conference, Vancouver, B.C., Canada, co-authored, 1998.

"Polynuclear Aromatic Hydrocarbon Contamination in Downtown Chicago Fill Soils," Proceedings of the Association of Engineering Geologists Annual Meeting, Chicago, Illinois, co-authored, 1991.

"Characterization of Hydrogeology and Groundwater Contamination at a Creosote Wood Treating Plant in Southern Illinois," Annual Meeting Association of Engineering Geologists, Winston-Salem, North Carolina, 1985.

"Hydrogeologic Model of a Hazardous Waste Site, South-Central Kansas," International Association of Engineering Geologists International Symposium, Management of Hazardous Chemical Waste Sites, Winston-Salem, North Carolina, co-authored, 1985.

"In-Situ Measurement of Hydraulic Conductivity and Recharge through Wisconsinan Age Till, Northeastern Illinois," Annual Meeting Geological Society of America, Reno, Nevada, 1984.

"Recent Landslides in San Onofre Bluffs State Park," South Coast Geological Society Guidebook, Oct. 20, 1979 Field Trip, Guidebook to Selected Geologic Features Coastal Areas of Southern Orange and Northern San Diego Counties, California, 1979.

"Recency of Faulting on the Mount Soledad Branch of the Rose Canyon Fault Zone in Northwestern Metropolitan San Diego," Annual Meeting Geological Society of America, San Diego, California, co-authored, 1979.

"Geology of the Proposed Camp Pendleton LNG Site, San Diego, California," American Association of Petroleum Geologist Guidebook No. 46, Geologic Guidebook of San Onofre Nuclear Generating Station and adjacent regions of southern California, 1979.

"Sandstones Cemented by a Relict Phyllosilicate, San Diego, California," Transactions of the San Diego Society of Natural History, Vol. 18, No. 15, co-authored, 1977.

"Petrography and Metamorphism of the Morena Reservoir Roof Pendant, Southern California," California Division of Mines and Geology Special Report 129, co-authored, 1976.

"Petrography, Structure and Metamorphic History of a Metasedimentary Roof Pendant in the Peninsular Ranges, San Diego County, California," Cordilleran Section Annual Meeting, Geological Society of America, Pullman, Washington, co-authored, 1976.

Other

I have no relatives employed by a public international organization. There are no restriction that should be taken into account in connection with my employment with the United Nations.

experience in environmental management, water resources development, and private power development for multilateral organizations. Extensive experience preparing international project. Monitored multilateral donor policies, activities and opportunities

- **Managed Climate Change Initiative:** Technical advisor to the El Salvador Ministry of Environment on the implementation of the Clean Development Mechanism office and development of a joint implementation pilot project. Explored funding possibilities, links to on-going and planned activities within the multilateral community, and development of terms of reference for institutional strengthening and joint implementation programs. Technical advisor to the Chicago Department of Environment on funding and program possibilities for collaborations with private industry to address emissions reductions and technology transfer opportunities. Developed project specifications and pilot program for a 300,000 ha GIS system in Venezuela addressing resource management, environmental impact mitigation, hydropower generation potential, and links between climate and power production.

- **Managed the Energy and Environment USAID IQC:** Contract concerned energy efficiency projects and energy sector reform. Task orders focused on energy sector reform in Eastern Europe and energy efficiency projects in Brazil, India and Eastern Europe. Prepared task order responses, managed expert teams for projects and served as climate change expert for the team of 10 consulting firms.

- **Project Manager and Technical Expert** for a market research study for the European Space Agency on uses of satellite imagery and geographic information in civil engineering projects. Researched global civil engineering market trends; assessed applications of satellite and radar imagery to present and future engineering markets. Developed a pilot project useing imagery to monitor deforestation and corresponding increases in greenhouse gas emissions.

- **GIS manager** for development of a national irrigation master plan for Jamaica. Duties include GIS establishment; coordination of an in-country GIS training involving participants from 5 government agencies; analysis of integrated land use and socio-economic variables; prioritization of proposed projects; extensive contact with the client and various government agencies; and assistance with project management and production of the final master plan and map atlas

- **Deputy Project Manager** for environmental and economic assessment of proposed inland navigation system on the 2,100-km Orinoco-Apure river system in Venezuela. Responsible for project administration, Spanish and French document translation, maintenance of project files, and communication with partners and subcontractors.

- **Deputy Project Manager** for an 18-km navigation and flood control project in Korea. Coordinated subcontract activities, reviewed contracts, tracked budgets, prepared progress reports, and researched similar projects, Harza provided technical guidance and review in the areas of civil, structural, geologic, geotechnical, hydraulic, sedimentation, water quality, coastal morphology, navigation, ports and harbor engineering, and economics during both the planning and general design phase.

- **Remote sensing specialist** for irrigation management project, Pakistan. Responsible for image acquisition, land cover classification, establishment of sampling points, design of data collection form, and training of in-country counterparts in interpretation of satellite imagery.

- **Performed environmental assessment** and created GIS for an irrigation project in Ghana. Primary issues were health impacts, water quality impacts from agrochemical use, preservation of lagoon environments and resettlement.

- **Remote Sensing Advisor** on possible uses of satellite imagery in the Kazakstan Irrigation and Land Reclamation Project, also responsible for image acquisition. Harza, in association with Nippon Koei, completed the first phase of project with production of the Five Year Irrigation and biomass production for a French pasture-monitoring research project. Worked frequently with FAO, UNDP, World Bank, AEDES, USAID, and a variety of short-term consultants. Activities included project planning, development, and coordination; cost analysis and budgeting; negotiations with AID, AEDES' early warning project, and Chadian agencies

- **Peace Corps**, Niamey, Niger, **Forestry Field Coordinator.** Main responsibilities included windbreak establishment and nursery management (75,000 trees/year). Implemented nursery improvements included species selection, seed collection, seedling care, and planting and watering techniques. Experimented with seed treatments and germination rates of 10 native species. Supervised nine workers and organized village participation in mini-nurseries' management. Worked with four villages in delineation and planting of 45 km of windbreaks. Decreased windbreak establishment time from 10 days to three. Directed nursery and plantation construction and supervised planting of more than 175,000 trees. Established 43 ha of village plantations using native species.

- **University of Minnesota**, St. Paul, Minnesota, 1986-1989 **Research Assistant.** Worked with county planning division to design and implement countywide GIS that incorporated satellite images, digital elevation models, and derived data to estimate soil erosion. Analysis involved the use of Erdas, ArcInfo, Epp17, and AGNPS Software packages. Provided training and technical assistance in use of several GIS and remote-sensing analysis packages

- **U.S. Forest Service, London, Kentucky, Forester.** In charge of location and establishment of forest inventory plots through use of maps, aerial photos, and field notes. Responsible for sampling and classifying information, including land use, forest type, species, height, diameter, volume, and timber quality estimates. Constructed sampling and area maps (1986).

- **Peace Corps, Nepal, 1986.** Data Analyst. Carried out data collection and statistical analysis for agricultural research project, Nepal. The project involved research of several varieties of quinoa for agricultural production (1986).

AREAS OF SPECIALIZATION

- *Troxler Nuclear Density Testing*
- *Heavy Equipment Operator*
- *CERCLA Hazardous Waste Training*
- *48-Hour Supervisor*
- *Certified Well Driller*
- *Environmental Technician*
- *CPR and First Aid Training*
- *Commercial Drivers License, Class B*
- *RAD Worker Level II Training*
- *Certified OSHA Safety Supervisor*
- *Soil*
- *Concrete*
- *Geotechnology*

FOREIGN LANGUAGES

- *Fluent in French and Spanish*

Representative Experience

Serves as field supervisor on environmental projects with over 25 years of experience in soil boring, well installation and special testing. Responsible for the safety of drill crews and environmental protocol.

- Master Driller in charge of field drilling operations for world's tallest building. Responsibilities included drilling, sampling, preparing borings for pressuremeter testing and Goodman Jack testing.
- Performed as Master Driller for the United Center and Comisky Park. Involved with drilling, sampling, pressuremeter testing and the installation of inclinometers.
- Acted as crew leader for borings performed at Fermi National Accelerator Laboratory. These borings included coring and sampling and were completed under difficult access and working conditions inside the enclosure for the B0 project.
- Master Driller involved with a project for Ohio Department of Transportation involving borings performed on alum sludge ponds where an all-terrain drill rig was driven on to the alum ponds with the help of geotextiles. Special testing procedures including vane shear testing, Osterberg piston sampling and over fifty 3 inch undisturbed samples.
- Responsible for drilling and coring on the Dresden Island Dam spillway with all-terrain drill and gas powered skid rigs.
- Master Driller in charge of drilling at O'Hare International Airport retention pond. Borings were performed at night under winter drilling conditions. Special sampling procedures were needed to account for full sample recovery from 80 foot borings. Sampling methods included Moss sampler, Osterberg sampler, Giddings sampler, and Pitcher Barrel sampler.
- Has provided drilling expertise for geotechnical high-rise foundation projects throughout the City of Chicago.
- Served as Master Driller for an environmental project in

Kalamazoo, Michigan with borings in excess of 350 feet depth. Special sampling included the use of a hydropunch water sampling device.

Versed in the operation of the following drill rigs:

Mobile B-61HD, B-57, B-47
CME 750, 550, 55, 45
Diedrich D-50
Joy 12B
Joy 12B gas skid rig
Acker air powered skid rig
Electric skid rid
Longyear 65

Drilling and sampling methods utilized:

Rotary
Solid Flight Augers
Hollow Stem Augers
Rock Coring
Shelby Tube Sampling 2"/3"/5"
Split Spoon Sampling 2"/3"/5"
Osterberg Piston Sampling
Giddings Sampling
Packer Testing
Pitcher Barrel Sampling

- Serves as field supervisor in the operation and maintenance of STS' 23-ton cone penetrometer vehicle. Responsible for the performance of electric standard and piezocone tests, installation of PVC mini-wells, direct push soil sampling with two and three inch split spoons and shelby tubes, and gamma logging. Representative projects include:
- Supervisor of direct push soil sampling, mini-well installation and gamma logging to depths of 40 feet for the DOE Palos Park Environmental Project near Chicago, Illinois. Performed over 90 test locations over a 2 month period under stringent environmental and radioactive guidelines.
- Operator of electric CPT test equipment to delineate stratigraphy to depths of 75 feet at a plant in Superior, Wisconsin. Work was performed in January during hard

ground conditions and included automatic decontamination of rods and self-grouting of holes in creosote impacted soils.

- Assistant in the performance of electric piezocone, mini-well installation and hydropunch groundwater sampling in very dense glacial till at the Argonne National Laboratory 317/319/ENE site characterization.
- Site Safety Officer for Kerr-McGee radioactive project in West Chicago, Illinois.
- Supervisor at Lindsay Light project in Chicago, Illinois.
- Water treatment monitoring for KMRC in state and out-of-state.
- Monitoring soil remediation site.

Keith A. Carlson, CIH

Senior Industrial Hygienist

AREAS OF SPECIALIZATION

- *Health and Safety Compliance*
- *Indoor Air Testing*
- *Local Exhaust Ventilation Design*
- *Indoor Air Quality (Sick Building Syndrome/Building-Related Illness*

EDUCATION

M.S., Industrial Hygiene, University of Minnesota, 1978

B.A., University of Minnesota, 1974

CERTIFICATIONS

Certification in the Comprehensive Practice of Industrial Hygiene, by the American Board of Industrial Hygiene, 1980

40-Hour Hazardous Material/Emergency Response Training

8-Hour Hazardous Material Site Supervisor Training

Certified Asbestos Building Inspector, State of Minnesota

Representative Experience

Mr. Carlson serves as the Certified Industrial Hygienist for the Environmental Services Group. With over 24 years in the health and safety consulting industry and over 20 years of experience with Sick Building Syndrome issues, Mr. Carlson enables the air quality team to provide a truly comprehensive package of air quality services. Mr. Carlson's clients include a wide variety of industrial clients, schools, hospitals, laboratories and government clients. Representative experience includes:

- Oversight and implementation of indoor air quality investigations.
- Development and presentation of safety training courses/classes (e.g. Employee Right to Know, Confined Space Entry, Lock-out Tag-out, Personal Protective Equipment, Process Safety, Hazmat/Spill Training).
- Development of written safety programs (e.g. AWAIR, Employee Right to Know, Respirator Lock-out Tag-out, Confined Space Entry).
- Occupational Safety and Health (OSHA) type safety and health inspections. This includes both safety and chemical exposure compliance activities.
- Site Safety Plan Development (for hazardous material sites).
- Instructor for Midwest Center for Occupational Health and Safety (1982 – Present)
- Design and testing at local exhaust ventilation systems.
- Expert witness testimony.

AFFILIATIONS

American Academy of Industrial Hygiene

American Industrial Hygiene Association (National and Upper Midwest Chapter)

American Conference of Governmental Industrial Hygienists

Midwest Center for Occupational Health and Safety (Instructor)

Minnesota Safety Council

Publications and Presentations

Presentation at the American Industrial Hygiene Association, "Facility Surface Dust Containing Lead from Soldering Operations", Atlanta, Georgia, May 1998.

Indoor Air Quality, Minnesota RIMS Seminar, February 1998.

OSHA Safety and Health Care Facilities, Minnesota Health Care Facilities, Minnesota Health Care Conference, September, 1997.

"Risk Assessment in the Clinic and Ambulatory Setting", Safety for Health Risk Management, November 1996.

"Indoor Air Quality", Internal Facilities Manager's Association, August, 1995.

APPENDIX B

TEACHERS' RETIREMENT SYSTEM - GMO SITE

STANDARD OPERATING PROCEDURE

APPENDIX B

Title: Standard Operating Procedure

Revision Number: 0

Date: Replaces: New

STANDARD OPERATING PROCEDURE

GAMMA RADIOLOGICAL SURVEYS

Title: Gamma Radiological Surveys

Document SOP-210

Revision Number: 0

Date: Replaces: New

Gamma Radiological Surveys

1. PURPOSE

This procedure provides protocols for pre-verification or verification gamma radiological surveys.

2. SCOPE

Radiological surveys will be performed at the designated Site as part of the pre-excavation, excavation, pre-verification, and/or verification surveying programs.

3. REFERENCES

3.1 None.

4. EQUIPMENT AND MATERIALS

The following equipment may be used as part of the survey programs. Other equipment may be substituted if necessary because of availability of the items listed or the conditions encountered at the site.

4.1 Trimble Pathfinder Pro XL 4.1 GPS (optional).

4.2 2-inch by 2-inch NaI (T1) gamma detector.

4.3 Ludlum Model 2221 portable scaler ratemeter analyzer.

5. INSTRUCTIONS FOR RADIOLOGICAL SURVEY

5.1 Land Survey Procedure

5.1.1 Two perpendicular baselines will be established.

5.1.2 A grid along the baseline will be established using cloth or steel tape and a compass, if necessary. Stakes, survey flags, or paint will be placed as needed to delineate grid or traverse lines. The grids will be spaced about one (1) meter apart.

5.1.3 The baseline, permanent structures, areas of remediation, and other areas of interest will be illustrated in the field logbook.

5.2 Gamma Survey Procedure

5.2.1 The Ludlum ratemeter is set for 2-second time-weighted average count rate.

5.2.2 Hold the survey meter probe parallel to the ground surface at a height of approximately two to six inches.

5.2.3 Walk along grid lines at a maximum speed of about 0.5 meters per second (1 mile per hour).

5.2.4 Continue surveying until all survey grids have been traversed.

5.3. Radiological Survey of On-Site Materials

5.3.1 Material that is excavated and placed in the clean stockpile will be surveyed two times. The first survey will be performed prior to excavation activities.

5.3.2 The second survey will be performed during the excavation of the non-contaminated soil.

The soils will be surveyed before they are placed in the stockpile. Based on the gamma scan, the material will either be designated as contaminated material and immediately loaded for transportation and disposal or tentatively designated as clean and stockpiled for subsequent soil sampling per SOP-214.

5.4. Daily Surveys

5.4.1 Routine daily surveys shall be performed for each day of operations at the site.

5.4.2 The routine surveys will monitor areas in the immediate vicinity of excavations and along soil movement paths to ensure that radiation levels are not affected by activities.

5.4.3 Routine surveys shall be documented by preparing a drawing of the survey results in the field logbook, indicating either the location and value of individual measurements, or contours of the measured gamma field.

5.4.4 Surveys of excavation areas will be made at the request of the Field Team Leader to assess the progress of the removal. These surveys will not be documented, but will be used by the Field Team Leader to manage the excavation.

5.5 Pre-Verification or Verification Survey

5.5.1 Upon completion of excavation activities, either a pre-verification survey shall be performed to ensure that the excavation is ready for a final verification survey by U.S. EPA or a verification survey shall be performed to ensure that the excavation that the excavation is ready for backfill based on U.S. EPA approval.

5.5.2 The survey is conducted at the same time as the excavation work phase. The survey method is performed as specified in Sections 5.1 and 5.2. Upon completion of the survey and excavation phase, a Notification of Successfull Pre-Verification or Verification is sent to the U.S. EPA requesting a final verification survey or approval to backfill.

STANDARD OPERATING PROCEDURE

AIR MONITORING PROCEDURE

Title: Air Monitoring Procedure

Document SOP-212

Revision Number: 0

Date: Replaces: New

Air Monitoring Procedure

1. PURPOSE

This procedure describes the methods to be used for sampling and measurement of airborne radioactive materials. The measurement data will be used to evaluate the effectiveness of health and safety measures at the work site. Controls will be established as necessary based upon the measurements to ensure regulatory compliance and appropriate protective measures for workers and the public.

2. SCOPE

This procedure applies to field activities that may generate dust or airborne emission from the site. The Respondents will establish background and/or site environmental monitoring stations to measure background air quality in the area. The objectives of the air sampling program described in this plan are to collect sufficient air samples during soil excavation to assure that excessive airborne contaminated dust is not being released.

3. REFERENCES

3.1 Code of Federal Regulations, Title 10, Part 20, Standards for Protection Against Radiation.

3.2 IAC application (page 6-2 of environmental analysis).

3.3 Kerr-McGee Environmental Air Monitoring Program Appendix I.

4. EQUIPMENT AND MATERIALS

The following equipment may be used as part of the survey programs. Other equipment may be substituted if necessary because of availability of the items listed or the conditions encountered at the site.

4.1 Environmental Monitoring Stations (EMS).

4.2 Alpha Counter (Ludlum Model 2000 Scaler with a 43-10 scintillation detector).

4.3 Low-Level Alpha Counter (Gamma Products G5000 or equivalent).

4.4 Daily Work Area Air Monitoring Sheet, Form SOP 212-1.

5. INSTRUCTIONS

5.1 Background Air Monitoring Locations

If background air monitoring stations are used, Kerr-McGee will use the REF background air monitoring station #17, located 2 miles north of the REF, to measure background air quality in the area. Information from this station will be interpreted to be representative of area-wide background air quality.

5.2 Site Air Monitoring Locations

5.2.1 A minimum of four air monitoring stations shall be used during the excavation activities.

5.2.3 Air monitoring locations will be located near the center of each quarter of the Site.

Workers will wear personal air monitors to evaluate the air quality at the worker's breathing zone. The high volume air samples are intended to monitor the amount of contaminants leaving the site and the personal air monitors are intended to monitor a workers exposure.

5.3 Air Sampling Requirements

5.3.1 Air shall be drawn into the sample at a height between 1 and 2 meters above the ground.

5.3.2 The minimum detectable activity (MDA), measured in µCi/ml, shall be re-established following equipment modification or replacement.

The two Gamma Products G5000 systems are the primary counters used for alpha counting. The Ludlum Model 2929/43-10 is used only for backup in the event both G5000 systems are down for repair. The alpha counting effectiveness and MDAs for the G5000 and Ludlum systems are similar.

5.3.3 Air samples filters shall be collected at least daily during excavation activities.

5.3.4 Flow rate through samples should be between 4 and 6 cubic feet per minute (cfm).

5.4 Radiological Analysis

5.4.1 Radiological analysis shall be performed in accordance with the West Chicago Facility Quality System procedures.

5.4.2 Samples will be analyzed for gross alpha concentration with counting performed at the REF. Air filters are counted for 30 minutes for Th-alpha and three minutes for Pb-212.

5.4.2.1 A five-hour minimum waiting period from the time of collection to the time of counting will be observed to allow decay of short-lived uranium progeny and ingrowth of short-lived thorium progeny.

5.4.3 Contribution of site activities to airborne radioactivity shall be determined as follows:

5.4.3.1 The net counts are divided by the counter efficiency and volume of the sample to obtain the air concentration.

5.4.3.2 The air concentration will be compared to the most limiting effluent concentration limit for Thorium-232 ($4x10^{-15}$ µCi/ml).

5.4.3.3 Samples exceeding the effluent concentration limit will be further evaluated to ensure that doses to individual members of the public are in compliance. Evaluations may include additional analyses to determine specific isotopic concentrations.

5.4.3.4 Annual average concentrations of radioactive material released in airborne effluents shall not exceed the effluent concentrations as specified in the January 1, 1994 revision of 32 IAC 340.

5.5 Investigation

5.5.1 The Offsites Manager or designee will perform investigations and responses consisting of one or more of the following actions in the event that Action Levels are exceeded.

5.5.1.1 Verification of laboratory data and calculations.

5.5.1.2 Analyze and review probable causes.

5.5.1.3 Evaluate need for reanalysis or additional analysis on original sample.

5.5.1.4 Evaluate need for resampling.

5.5.1.5 Evaluate need for sampling of other pathways.

5.5.1.6 Evaluate need for notifications to regulators.

5.5.1.7 Dose assessments.

5.5.2 All investigations shall be documented.

5.6 Quality Control

5.6.1 All air samplers shall be in current calibration.

5.6.2 Sample chain-of-custody standard operating procedures will be followed for all samples.

5.7 *Sample Archive and Disposal*

5.7.1 All samples will be archived on-site in a suitable area until released by the Offsites Manager.

5.7.2 Samples will be disposed of according to the Sample Handling, Packaging and Shipping SOP (SOP-218).

FORM SOP 212-1

DAILY WORK AREA MONITORING SHEET

Sample Location	Reason for Sample	Date Time Sampler On:	Date Time Sampler Off:

Average Flow Rate ______________ X Total Sample Time ______________ = Sample Volume ______________

DATE	TIME	INSTRUMENT/ SERIAL NUMBER	GROSS FILTER WEIGHT	TARE FILTER WEIGHT	NET FILTER WEIGHT	TSP (mg/m³)	TOTAL COUNTS	COUNT TIME	CPM	BKGD CPM	CCPM	CF	µCi/ml	SIGNATURE

REMARKS:

Reviewed By:	Date:	Approved By:	Date:

STANDARD OPERATING PROCEDURE

SOIL SAMPLING PROCEDURE

Title: Soil Sampling Procedure

Document SOP-214

Revision Number: 0

Date: Replaces: New

Soil Sampling Procedure

1. PURPOSE

The purpose of this procedure is to present protocol for collecting soil samples for the Site.

2. SCOPE

This procedure applies to samples collected for radiological or geotechnical analysis. Soil samples may be collected of potential backfill soils or other soils. The Field Team Leader will coordinate the sampling efforts.

3. REFERENCES

3.1 Soil Sampling Procedure for Field Verification System and the Field Portable Units at the Kerr-McGee Rare Earths Facility, August 1994.

3.2 U.S. Nuclear Regulatory Commission, NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination, June 1992.

4. EQUIPMENT AND MATERIALS

4.1 Equipment and Materials Management

Downhole tools and samplers are cleaned in accordance with the Decontamination Procedure (SOP-WCP347) included in the Procedures Section of Appendix C of the QAPP.

Cuttings, fluids, samples, and water are placed in 55-gallons drums, labeled, properly stored on-site, and disposed of in a manner that does not violate local, state or federal rules or regulations and in a manner that does not damage public or private property.

4.2 Sampling Equipment and Materials

Equipment used for soil sampling includes the following:

- Auger or other Coring Tool
- Shovel and Trowel
- Plastic Collection Bags
- Plastic Sheets (optional)
- Sampling Tracking Form (Form SOP-214-1)

- Field Logbook (SOP-215)
- Field Sample Screening Form (Form SOP-214-2 or holding samples)
- Pin Flags (for marking sample locations)
- Container (for collecting potentially contaminated waste generated during the sampling process) (e.g., gloves, plastic sheets, etc.)
- Bucket (filled with clean rinse water)
- Bucket (for homogenizing samples)
- Stainless Steel Brush
- Moist Towelettes
- Paper Towels
- Latex Gloves
- Survey Instrument (for verifying clean sampling equipment and hands)

Other equipment may be substituted if necessary because of availability of the items listed or the conditions encountered at the site. Substitute equipment shall be documented in the Field Logbook and approved by the Field Team Leader.

5. SAMPLING PLAN

Selection of the sampling plan to characterize a soil is a function of the goals of the investigation, the variability of the parameters being measured, and the impact of the variability on the conclusions. Samples may be collected randomly or they may be collected from specific areas deliberately chosen to represent the range of conditions expected or unusual conditions of particular interest. In general, randomly chosen samples are appropriate to assess overall site conditions. However, there may be instances where the significance of an observed condition is of interest. The choice of method will, therefore, depend on the specific goals of the sampling activity.

The procedure presents sampling methods based on random sampling. For the reasons stated above, variations to the methods provided in this procedure may be requested by the Field Team Leader. Such variations shall be documented in the Field Logbook by field personnel.

6. ON-SITE STOCKPILE SOIL SAMPLING

The following are the steps to be followed for on-site stockpile soil sampling.

6.1. Excavated soil may be stockpiled. Samples from the stockpiles may be analyzed.

6.2. The soil may be stockpiled in piles varying from a few to several thousand cubic yards. Because of this potential variation in pile size, no single method for sampling or type of equipment can be prescribed that will work for every situation. The two basic methods that can be used for sampling stockpiles, core sampling method and lift sampling method, are described in paragraphs 7.3 and 7.4, respectively. Both methods are based on the premise that in order for a sample to be representative of the pile, every particle in the pile must have an equal probability of being included in the sample.

6.3. One of the methods, the core sampling method, assumes that the pile can be completely penetrated using a coring tool (i.e., sampling probe or drill rig). On conical shaped piles, the sample is to be taken approximately perpendicular to the surface of the pile, midway between the peak and the base, to the center of the pile. On piles with flattened tops, the sample is to be taken perpendicular to the surface from the top to the bottom of the pile.

6.4. The other stockpile sampling method, the lift sampling method, assumes that the pile can not be completely penetrated with a sampling tool, and therefore must be sampled either as the soil is placed in lifts onto the pile or before the soil is removed in lifts for use. The samples will, therefore, only be representative of the discrete layer of soil that is exposed to the sampling.

6.5. With either sampling method, to identify the areas to be sampled, the pile shall always be faced looking north. For flat topped piles, divide the stockpile into an imaginary grid with square or rectangular shaped sections approximately equal in area; the grids on flat topped piles should be numbered from left to right, top to bottom. For conical shaped piles, divide the stockpile into an imaginary grid with pie shaped sections of equal areas; the grids on conical shaped piles should be numbered in clockwise pattern.

6.6. Determine the initial number of grids and samples as follows:

Pile Size (cubic yards)	Number of Grids	Number of Lift Samples[1]	Number of Core Samples[2]
< 50	3	3	3
50 to 100	5	5	5
101 to 500	6	5	6
500 to 1,000	7	5	7
1,000 to 2,000	8	6	8
2,000 to 4,000	9	6	9
4,000 to 6,000	10	7	10
6,000 to 8,000	11	7	11
8,000 to 10,000	13	8	13
10,000 to 20,000	16	8	16
20,000 to 40,000	20	10	20
40,000 to 70,000	30	15	30
70,000 to 100,000	36	15	36
100,000 to —[3]	36+	15+	36+

Notes:

[1] Take one sample from each grid randomly chosen. In order to choose the grids to be sampled randomly, use some blank sample identification tags and number the tags from one (1) to (n), where (n) represents the number of grids in each pile. Put the tags into a sample bag, shake the bag and reach in and blindly select a tag. Continue selecting tags until the required number of grids are selected. The numbers will be chosen without replacement, that is, without returning the used number to the bag. The samples shall be taken from the grids that correspond to the randomly chosen numbers. An alternative method would be to use a computer generated random numbering system available in various spreadsheet programs (i.e., Excel).

[2] From the randomly chosen grids, take one composite sample for approximately every ten (10) feet of soil depth to obtain the required number of samples. For example: if a 98 cubic yard pile is 10 feet high, according to the above table, five (5) composite samples are required (i.e., one for each grid). If an 11,000 cubic yard pile is 30 feet deep, three composite samples, one composite sample at each ten feet of depth, will be taken from 5 of the grids and one composite sample will be taken from a sixth, randomly chosen grid.

[3] Add one sample for each additional 10,000 cubic yards.

6.7. Take the sample and submit it to the laboratory for analysis.

6.8. Statistically test the results of the sample analyses to determine how much uniformity the samples show and whether more samples must be taken.

6.9. If necessary, take additional samples and analyze. Continue to repeat steps 6.7 and 6.8 until there are enough samples to characterize the pile.

6.10. As directed by the Field Team Leader, identify materials suitable for backfill or other purpose for which the sampling was done.

6.11. To compare the sample data with the desired criteria, calculate the average (X bar of all the samples) in the pile using:

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$$

6.12. If the average satisfies the desired criteria, the results can be further evaluated to determine whether the data provide a 95 percent confidence level that the true mean (μ) meets the relevant criteria. The Field Team Leader will consult with the Offsites Manager to determine if this further evaluation is required.

7. IN-SITU SOIL SAMPLING

This section describes the methods for choosing sample locations and sampling methods.

7.1 Sample Location Selection

Appropriate in-situ soil sample locations are determined by the size and uniformity of the deposit being sampled. The sampling pattern depends upon the size of the area, the uniformity of the soil stratum being sampled, and the volume of soil that is being sampled.

Sampling plans for particular purposes may specify a pre-established sampling frequency in terms of the maximum volume of soil represented by a sample. If the soil being sampled is statistically homogeneous, then the locations for samples can be selected randomly over the area and thickness of the deposit. If the soil is not statistically homogeneous, then the area must be broken into subareas within which the soils are statistically homogeneous, and each area sampled separately. The issue of statistical homogeneity is resolved by comparing the range of variation of the property being judged to the acceptability criteria. For example, a deposit of sand and gravel may be statistically homogeneous when judged against a standard that the material not contain boulders and not be homogeneous when judged against a standard that no gravels be larger than one inch.

Clearly, also, the number of samples required to resolve the second comparison may be larger than the number required to resolve the first. The sampling frequencies given in the Sections 10.3 and 10.4 (Stockpile Sampling) may be used as a guide in estimating an initial number of samples, but the actual number required for a particular purpose depends very strongly upon the requirements and materials being sampled.

7.2 Drilling Procedures

In general, manual or power-auger assisted drilling will be used. Drilling will follow the procedures described in Section 10.2 and SOP-WCP655..

8. Operational Support Sampling

Sampling may be required to support the excavation and restoration action. This sampling may be performed in instances when the Field Team Leader is interested in the significance of an observed variation or when looking for cursory information to provide operational guidance. The choice of the method will, therefore, depend on the specific goals of the sampling activity as determined by the Field Team Leader. This sampling is not a quality activity, and may be performed outside the requirements of this procedure. However, all deviations requested by the Field Team Leader must be documented in the Field Logbook by field personnel.

The sampling technique for surface sampling, subsurface sampling, and stockpile sampling, as described in this procedure, shall be used when sampling in these instances.

9. Sample Tracking

To establish the documentation necessary to track the sample from the time of collection, the sample identification and Sample Tracking Forms must accompany samples that are sent to the laboratory.

All potentially contaminated samples to be submitted to the laboratory will be screened for radiation in the field. Information obtained from this survey will be documented on the Sample Tracking Form (Form SOP 214-1). Samples taken from potential borrow areas generally are not screened.

10. Sampling Methods

10.1 Surface Soil Sampling

10.1.1. If necessary, to minimize contamination, spread a clean sheet of plastic next to the area to be sampled; assemble the sampling equipment required.

10.1.2. Enter the complete information on the Sample Tracking Form:

- Sample Number
- Sample Matrix
- Sample Location
- Purpose of Sample Collection
- Include applicable comments regarding the sample, location, weather, conditions, or other factors that may be relevant

- Collected by (your name)

10.1.3. Mark the collection bag or prepare the identification tag for the sample.

10.1.4. Collect the soil samples that are representative of the soil in the area surveyed. Use a shovel or trowel to collect soil from the depth required.

10.1.5. Remove rocks, sticks, and foreign objects greater than approximately one (1) inch.

Stir and homogenize the soil in a bucket as much as practicable. Using the hand trowel, randomly scoop the soil from the bucket. Save alternating scoops of material to collect the required sample size; return the other material to the sampling locations.

10.1.6. Attach the identification tag to the sample bag if appropriate and place the bag in the sample container.

10.1.7. Decontaminate the sampling equipment as required by Section 11.

10.1.8. Return any location markers (such as pin flags) that were removed in order to sample. Fill in all sampling holes to eliminate a possible tripping hazard.

10.1.9. If specific data are not available, mark a pin flag with the sample identification number and place the flag at the center of the sampling location before leaving.

10.2 Subsurface Sampling (Undisturbed Soils)

10.2.1. If necessary, to minimize contamination, spread a clean sheet of plastic next to the area to be sampled; assemble the sampling equipment required.

10.2.2. Enter the complete information on the Sample Tracking Form:

- Sample Number
- Sample Matrix
- Sample Location
- Purpose of Sample Collection
- Include applicable comments regarding the sample, location, weather, conditions, or other factors that may be relevant
- Collected by (your name)

10.2.3. Mark the collection bag or prepare the identification tag for the sample.

10.2.4. Sample the material using a hand core sampling tool or hammer driven split spoon sampler.

Alternatively, an auger method may be used.

Cut a hole, approximately six (6) inches in diameter, in the center of a plastic sheet. Center the sheet of plastic over the area to be sampled. Using an auger, drill through the hole in the plastic to the desired sampling depth; keep the auger turning until no more material comes up. The soil around the hole, on the plastic sheet, is fairly well mixed and representative of the interval just drilled.

If the soil sample is to be obtained from a particular depth (not a composite from surface to depth), and the material refuses to pass into the coring tool, the following sampling method will be performed. Drill through the hole in the plastic to the top of the desired sampling depth; keep the auger turning until no more material comes up. Remove the auger and sample the material using a hand core sampling tool or hammer driven spilt spoon sampler. The first three inches of the sampled obtained will be considered slough and not part of the desired sample.

NOTE: If, due to the conditions of the sampling area, this method does not work, an alternative method(s), approved by the Field Team Leader, may be used. Alternative methods, when used, will be documented by the field personnel in the Field Logbook.

10.2.5. Remove rocks, sticks, and foreign objects greater than approximately one (1) inch in diameter.

NOTE: The removed rocks will be collected and submitted as a separate sample.

10.2.6. Using a hand trowel, collect approximately one (1) quart of the augured soil in the plastic sample bag or jar. For core segments, place each 6-9 inch (nominally 5-7 inch) segment in the plastic sample bag or jar.

10.2.7. Label the sample container.

10.2.8. Return unused material to the sampling hole and fill in the hole to eliminate possible tripping hazard.

10.2.9. Decontaminate the sampling equipment as required by Section 11.

10.2.10. When required, mark a pin flag with the sample identification number and place the flag at the center of the sampling location before leaving.

10.3 Stockpile Sampling (Core Sampling Method)

10.3.1. If necessary, to minimize contamination, spread a clean sheet of plastic next to the area to be sampled and assemble the sampling equipment required.

10.3.2. Enter the complete information on the Sample Tracking Form:

- Sample Number
- Sample Matrix
- Sample Location
- Purpose of Sample Collection
- Include applicable comments regarding the sample, location, weather, conditions, or other factors that may be relevant. Identify the approximate size of the stockpile. (A 70 cubic yard pile of soil is approximately ten feet high with a base diameter of approximately 26 feet.) Include a brief description of the equipment used to obtain the sample (i.e., sub-soil sampler, drill rig, etc.).
- Collected by (your name)

10.3.3. Before sampling, determine the number of grids and samples as described in Section 6.6. Record the information in the Field Logbook.

10.3.4. Mark the collection bag or prepare the identification tags for the samples.

10.3.5. Using an auger or other coring tool, take the required number of samples from the pile. A hollow stem auger will be used when discrete, rather than composite, samples are collected.

10.3.6. Place the sample material in the sample bag and attach the identification tags. Place the sample bag in the container.

10.3.7. Decontaminate the sampling equipment as required by Section 11.

10.4 Stockpile Sampling (Lift Sampling Method)

10.4.1. If necessary, to minimize contamination, spread a clean sheet of plastic next to the area to be sampled and assemble the sampling equipment required.

10.4.2. Enter the complete information on the Sample Tracking Form:

- Sample Number
- Sample Matrix
- Sample Location
- Purpose of Sample Collection

- Include applicable comments regarding the sample, location, weather, conditions, or other factors that may be relevant. Identify the approximate size of the stockpile. (A 70 cubic yard pile of soil is approximately ten feet high with a base diameter of approximately 26 feet.) Include a brief description of the equipment used to obtain the sample (i.e., sub-soil sampler, drill rig, etc.).
- Collected by (your name)

10.4.3. Before sampling, determine the number of grids and samples as described in Section 6.6. Record the information in the Field Logbook.

10.4.4. Mark the collection bag or prepare the identification tags for the samples.

10.4.5. Using the appropriate sampling tool, take the required number of samples from the lift approximately perpendicular to the surface of the lift at the appropriate locations. Composite the sample through the entire lift thickness.

10.4.6. Place the sample material in the sample bag and attach the identification tags. Place the sample bag in the container.

10.4.7. Decontaminate the sampling equipment as required by Section 11.

10.5 Soil Sample Size

10.5.1. Each soil sample will be a minimum of four (4) pounds and the sample may exceed 10 pounds. Sample size requirements are detailed in Sample Preparation Procedure for Gamma Spectral Analysis (SOP-WCP364).

11. Equipment Cleaning

To avoid cross-contamination, the sampling equipment will be cleaned prior to and between samples. The following steps will be followed to clean equipment.

Remove loose contamination by gently tapping/shaking the item.

Using the stainless steel brush or paper towels, remove material that did not dislodge.

If the item appears to be clean (i.e., no visible clinging soil), proceed to the next sampling area.

If the item does not appear to be clean or if a survey with the appropriate instrument does not verify that it is, scrub the item with water. While holding the item over the sampling location, rinse the item with water.

Dry the item with paper towels or repeat the scrubbing sequence as necessary.

Rinse gloved hands. Change gloves when changing sampling areas if a self-frisking indicates that contamination is present after rinsing.

Approximately one percent of the time, swipe the item as described in the Gamma Radiological Survey SOP (SOP-210). Submit the swipes to the laboratory for analysis to confirm the effectiveness of the decontamination protocol. (This step is necessary only when sampling soils where radiologic contamination is suspected.)

Dispose of cleaning materials, plastic sheeting, and gloves as contaminated materials in accordance with instructions provided by the Field Team Leader.

12. Quality Control

12.1 QC Samples

To evaluate the variance in the soil sampling protocol, field duplicates will be collected at specified intervals. These QC samples will be identified and noted in the Field Logbook.

To validate the sampling protocol used for surface sampling, initially one (1) area on every twenty (20) sub-grids sampled.

For surface sampling, the duplicates shall be randomly selected and identified before sampling activities begin. The duplicate sample material will be collected using the next scoop full of material each time the initial sample is saved.

For subsurface samples, one duplicate subsurface sample will be taken for every twenty (20) samples.

For subsurface sampling, the duplicate will be collected from the representative augered material.

For stockpiles, one duplicate will be taken for every twenty (20) stockpile samples, or one each day that stockpile sampling takes place, whichever is greater.

The stockpile duplicate will be taken from the node of two grids. The duplicates will be randomly selected and identified before the sampling begins.

The Field Team Leader will calculate the mean and the standard deviation for the samples analyzed. If the duplicate sample results are within three (3) standard deviations of the sample population, the sampling protocols can be considered acceptable.

If the Offsites Manager approves, the Field Team Leader can reduce the frequency of the QC duplicate sampling based on the results obtained. Changes shall be documented in the Field Logbook.

12.2 Data Review

Entries in the Field Logbook will conform to the Field Logbook Standard Operating Procedures.

Daily, the Field Team Leader will review the Field Logbook, resolve any discrepancies that were noted by field personnel, and sign the book to indicate the pages reviewed. If the Field Team Leader recorded the discrepancy, the Quality Assurance Supervisor will review the Field Logbook and resolve any discrepancies that were noted.

NOTE: Discrepancies relating to reported data will be brought to the attention of the Field Team Leader.

13. Health and Safety

- Personal protective equipment and clothing, as required by the Health and Safety Plan, will be used when collecting and handling contaminated soils.

The site radiological conditions will be determined and documented before sampling begins. During the sampling process, the principles of As Low As Reasonably Achievable (ALARA) will be followed.

14. Records

The following documents will be maintained as quality records:

- Field Logbooks
- Sampling Tracking Forms
- Results of all Calculations and Statistical Analyses Performed

FORM SOP-214-1

SAMPLE TRACKING FORM

Date: ____________________ Page ___ of ___

Sample Number	Matrix (S/W)	Location	Collected For	Comments	Collected By

Released by/Company	All samples listed above are hereby released except for:	Date/Time
Received by/Company	All samples listed are hereby received except for:	Date/Time
Received by/Company	Data for all samples listed above are hereby received except for:	Date/Time

FORM SOP-214-2

FIELD SAMPLE SCREENING FORM

Sample Type:	Sample ID Number:	
Date:	Time:	
Counting Instrument:	Sample Date:	
Reading Units:		
Signature of Technician:		Date:
Signature of Reviewer:		Date:

TEACHERS' RETIREMENTS SYSTEM - GMO SITE

FIELD LOGBOOK PROCEDURE

Title: Field Logbook Procedures

Document SOP-215

Revision Number: 0

Date: Replaces: New

FIELD LOGBOOK PROCEDURE

1.0 PURPOSE

This procedure describes standard protocol for the use and control of the Field Logbooks used during the Site remediation.

2.0 SCOPE

This procedure applies to field activities that are associated with the Site cleanup.

3.0 REFERENCES

STS Consultants, Ltd. Quality Assurance Manual

4.0 EQUIPMENT AND MATERIALS

Field Logbook.

Indelible pen or pencil.

5.0 INSTRUCTIONS

5.1 Field Logbook Format

5.1.1 Prior to entering the field, page numbers shall be assigned to the pages of the Field Logbook. Pages shall include the date. STS may use pre-printed Field Logbooks in which some of these items are filled in. Each Field Team Leader and other field personnel taking measurements, observing tests, or performing other related work, will be issued a Field Logbook.

5.1.2 The first set of pages for a day will include the following items (in the order indicated):

- personnel on site
- contractor personnel on site (names of employees for the companies represented)
- others on site (e.g., regulators, visitors)
- weather
- equipment used
- equipment calibration
- sketch of work area
- summary of work.

5.1.3 The remaining pages for a day will record the field activities and should include the following:

- meetings (meeting attendees, person who called the meeting, time, location, decisions, and decision makers)
- *start and end time of activities*
- visits by others
- regulator - directed activities
- comments madê by regulator, visitor, or other persons visiting Site
- weather and working conditions
- general description of work area
- sketch work areas and show significant relative locations, etc.
- progression of work (e.g., faster or slower, reason for delays)
- description of equipment used, including general name, brand name, model number and, calibration
- description of amount of material excavated and levels of contamination observed (if known)

5.2 Quality Control

5.2.1 The Field Team Leader, or his designee, will review field logbooks for completeness, proper field note correction (single line strikeout), and content.

5.2.2 Field logbooks will be audited at the discretion of the Project Quality Assurance Supervisor.

STANDARD OPERATING PROCEDURE

VERIFICATION SURVEY

Title: Verification Survey

Document SOP-223

Revision Number: 0

Date: Replaces: New

Verification Survey Procedure

1. PURPOSE

The purpose of this procedure is to present protocol for conducting verification surveys at the excavations at the Site.

2. SCOPE

This procedure applies to all completed excavations that are done as a result of the excavation area being identified as containing soil exceeding the cleanup criteria.

3. REFERENCES

3.1 SOP 210, Gamma Radiological Survey

3.2 Quality Assurance Project Plan

4. EQUIPMENT AND MATERIALS

None

5. PROCEDURE

5.1 EQUIPMENT AND MATERIALS

Equipment used for verification survey may include the following:

5.1.1 Compass or theodolite

5.1.2 Cloth or steel tape

5.1.3 Stakes, survey flags, or spray paint

5.2 GRID LAYOUT

5.2.1 The verification survey will be conducted at all excavations.

5.2.2 The grid used for the STS Survey, or similar locations will be re-established for the verification survey.

5.2.3 The diagonals across each grid square will be located.

5.2.4 The location halfway between the grid corner and the center of the grid will be surveyed.

5.3 VERIFICATION

5.3.1 Measurements will be made according to the procedures described for Gamma Radiological Surveys (SOP-210).

5.3.2 If all measurements within a grid are less than the cleanup criteria limit, then grid is clean. No further excavation is required in this grid.

5.3.3 If any measurements within an excavation are greater than the action criteria limit, then the Field Team Leader shall guide additional soil removal until the excavation measures below the cleanup criteria.

6. DOCUMENTATION

6.1 A scale drawing of the survey area showing the locations and results of the gamma measurements will be created.

6.2 The drawing and gamma measurements will be delivered to the U.S. EPA with a Notice of Successful Verification and a request for approval to backfill the excavation (Form SOP 223-1).

7. QUALITY CONTROL

7.1 Quality control for the verification documentation will be in accordance with applicable quality assurance SOPs in the Quality Assurance Project Plan for the Site.

FORM 223-1
NOTIFICATION OF SUCCESSFUL VERIFICATION SURVEY

Area Identification: ____

Date of Verification Survey: ____

Time of Verification Survey ____am/pm

The above-described excavation was surveyed at the time and date indicated above. The survey indicated that all soils have been removed as required by the Site Removal Action Criteria.

Documents pertaining to this survey are attached for review and approval by the U.S. EPA.

Signed:

____ Date ________

____ (Print Name)

____ (Print Title)

For Kerr-McGee Chemical Corporation

____

The attached Verification Survey documents were reviewed by U.S. EPA, Region V on ____________________. The results of this survey indicate that the verification criteria as contained in the UAO, have been met.

Authorization is hereby granted to commence backfill and restoration work at this excavation.

Signed:

____ Date ________

____ (Print Name)

____ (Print Title)

For U.S. EPA Region V

TEACHERS' RETIREMENT SYSTEM - GMO SITE

STANDARD OPERATING PROCEDURE

Title: Radioactive Material Shipments

Document SOP-LLII320

Revision Number: 0

Date: Replaces: New

RADIOACTIVE MATERIAL SHIPMENTS

1.0 SCOPE

1.1 Purpose

To establish a procedure that will insure the safe and proper shipment of radioactive *waste* material off-site in compliance with IDNS, NRC, and DOT regulations.

1.2 Applicability

This procedure is applicable at all times for all limited quantity, LSA, and Type A-Yellow II shipments of radioactive materials destined for off-site locations.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 State of Illinois Department of Nuclear Safety License Number STA-583

2.5 10 CFR Part 20.1906

2.6 10 CFR Part 71.47 and 71.87

2.7 10 CFR Part 71 Statements of Consideration

2.8 I&E Information Notice 85-46: Clarification of several Aspects of Removable Radioactive Contamination Limits for Transport Packages

2.9 49 CFR Parts 172 and 173

2.10 32 Illinois Administrative Code, Part 341, Transportation of Radioactive Material

2.11 Utah Radioactive Material License No. *SMC-1559* with current amendments issued to Envirocare of Utah, Inc.

2.12 West Chicago Project, Operations' Radioactive Waste Shipment & Disposal *Record* Procedure - WCP 617.

2.13 DOT exemption #E11075 granted to Kerr-McGee Chemical Corporation, Oklahoma City, Oklahoma, September 2, 1994.

2.14 Operations' Bill of Lading Procedure - WCP-614.

2.15 Survey and Decontamination of Railcars Procedure, WCP-632.

3.0 DEFINITIONS

3.1 A_1

This is the maximum activity of special form radioactive material permitted in a Type A package.

3.2 A_2

This is the maximum activity of radioactive material, other than special form radioactive material, permitted in a Type A package.

3.3 Limited Quantity of Radioactive Material

This is the quantity of radioactive material that does not exceed the materials package limits specified in 49 CFR 173.423 and which conforms with the requirements specified in 49 CFR 173.421.

3.4 Low Specific Activity (LSA)

LSA material is any of the following:

3.4.1 Uranium or thorium ores and physical or chemical concentrates of those ores.

3.4.2 Unirradiated natural or depleted uranium or unirradiated natural thorium.

3.4.3 Tritium oxide in aqueous solutions provided the concentration does not exceed 5.0 millicuries (185 MBq) per milliliter.

3.4.4 Material in which the radioactivity is essentially uniformly distributed and in which the estimated average concentration per gram of contents does not exceed:

a. 0.0001 millicurie (3.7 kBq) of radionuclides for which the A_2 quantity in Appendix A of 32 IAC 341 is not more than 0.05 curie (1.85 GBq).

b. 0.005 millicurie (185 kBq) of radionuclides for which the A_2 quantity in Appendix A of 32 IAC 341 is more than 0.05 curie (1.85 GBq), but not more than 1 curie (37 GBq); or

c. 0.3 millicurie (11.1 MBq) of radionuclides for which the A_2 quantity in Appendix A of 32 IAC 341 is more than 1.0 curie (37 GBq).

3.4.5 Objects of non-radioactive material externally contaminated with radioactive material, provided that the radioactive material is not readily dispersible and the surface contamination, when averaged over an area of 1 square meter, does not exceed 0.0001 millicurie (220,000 transformations per minute) (3.7 kBq) per square centimeter of radionuclides for which the A_2 quantity in Appendix A of 32 IAC 341 is not more than 0.05 curie (1.85 GBq), or 0.001 millicurie (2,200,000 disintegrations per minute) (37 kBq) per square centimeter for other radionuclides.

3.5 Package

This is the packaging together, with its radioactive contents as presented for transport.

3.6 Packaging

This is the assembly of components necessary to ensure compliance with the packaging requirements of 32 IAC 341. It may consist of one or more receptacles, absorbent materials, spacing structure, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie down system, and auxiliary equipment may be designated as part of the packaging.

3.7 Radioactive Material

Any material having a specific activity greater than 2.0 E-03 μCi/g. (49 CFR 173.403); ***2000 pCi/g***

3.8 Transport Index (TI)

This is the dimensionless number (rounded up to the first decimal place) placed on the label of a package to designated the degree of control to be exercised by the carrier during transportation. The transport index is the number expressing the maximum radiation level in millirem per hour at 1 meter from the external surface of the package.

3.9 Type A Quantity

This is a quantity of radioactive material, the aggregate radioactivity of which does not exceed A_1 for special form radioactive material or A_2 for normal form radioactive material, where A_1 and A_2 are given in Appendix A of 32 IAC 341 or may be determined by procedures described in Appendix A of 32 IAC 341.

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 A copy of ***the consignee's*** up-to-date radioactive material license ***shall*** be on file at the Kerr-McGee West Chicago Facility, ***so the Site Manager or his designee can verify*** that the consignee is licensed to receive the radioactive material.

4.1.2 All containers shall be inspected by the Site Manager ***or designee*** prior to loading ***and*** palletizing, to insure that the container's integrity is adequate, and ***then inspected again to insure*** that the containers have been loaded and closed in accordance with applicable Kerr-McGee procedures.

4.1.3 For shipments of radioactive material for disposal, compliance with disposal site facility criteria and specific state and federal license provisions applicable to the material shall be verified by Site Manager.

4.1.4 For packages of ***radioactive*** waste material intended for shipment to Envirocare of Utah for disposal, the Site Manager or ***designee*** shall verify that the pre-shipment characterization ***process has*** been completed.

4.2 Tools, Material, Equipment

4.2.1 Calculator.

4.2.2 ***Packaging, lables and containers***

4.3 Precautions, Limits.

4.3.1 ***Radioactive waste material that is to be*** shipped for disposal must be classified according to 32 IAC 340.1052 and meet the requirements of 32 IAC 340.1055.

4.3.2 The maximum permissible limits for removable contamination for a package:

Contaminant	$\mu Ci/cm^2$	dpm/cm^2
Beta/gamma emitting nuclides; nuclides with $T_{1/2}$ <10 days; natural uranium; natural thorium; U-235; U-238; Th-232; Th-228; and Th-230 when contained in ores or physical concentrates.	10^{-5}	22
All other alpha emitting nuclides	10^{-6}	2.2

NOTE: In cases of packages transported as exclusive use shipments by rail or highway, the non-fixed radioactive contamination must not exceed the above limits at the beginning of transport, and, at any time during transport, must not exceed 10 times the above limits.

4.3.3 The radiation levels at any point on the external surface of the package must not exceed 200 mrem/hr and the Transport Index must not exceed 10. Packages transported as exclusive use by rail or highway may exceed these limits provided that the following conditions are met:

	Open Vehicle	Closed Vehicle
Package Surface	≤ 200 mrem/hr	≤ 1000 mrem/hr
Vehicle	≤ 10 mrem/hr at 2 meters from vertical planes ≤ 2 mrem/hr in cab	≤ 200 mrem/hr at any point on the outer surface of the vehicle ≤ 10 mrem/hr at 2 meters from vertical planes ≤ 2 mrem/hr in cab

4.3.4 Under DOT Exemption #E11075, the radiation levels at any point on the external surface of a railcar carrying ***radioactive waste material*** to ***disposal facility***, must not exceed 10 mrem/hr.

4.4 Acceptance Criteria

4.4.1 Radioactive material has been properly prepared, packaged, marked, labeled, and loaded onto a vehicle and is in proper condition for transport.

4.4.2 All necessary forms, surveys, and manifests have been prepared and the "shipping papers" packet is complete.

4.4.3 All necessary state and local authorities and material receivers have been properly notified of the shipment.

4.4.4 All necessary paperwork has been completed and signed and a copy of the "shipping papers" packet has been filed for Kerr-McGee's records.

4.4.5 For ***radioactive*** waste shipments for disposal, confirmation of receipt at the disposal facility is acknowledged within 20 days of shipment, or an investigation is initiated.

4.4.6 Deleted

5.0 PROCEDURE

5.1 Verify that the intended consignee (receiver) of the material has a valid license to accept the type and quantity of radioactive material.

> <u>NOTE</u>
> Typically, groundwater samples, surface water samples, and environmental air samples that are shipped offsite do not meet the regulatory definition of "Radioactive Material" and therefore do not require radioactive material shipping paperwork.

5.1.1 The A_1 and A_2 values for radionuclides are the limits in curies from which a shipment type is determined.

5.2 If the package activity does not exceed 10^{-3} A_2 curies, the radiation level on the external surface is $\leq$ 0.5 mrem/hr, and the package meets the other requirements of 49 CFR 173.423 and 49 CFR 173.421, it may be shipped as "LIMITED

QUANTITY," and a bill of lading will normally be used, although they are not required by regulation. Go to Step 5.5. for "LIMITED QUANTITY" shipments.

5.3 Determine the following information for inclusion on the bill of lading ***and/or the radioactive waste shipment & disposal record*** form for each package in the intended shipment:

5.3.1 Proper shipping name and hazard class from 49 CFR 172.101, Columns 2 and 3.

5.3.2 Proper UN identification number from 49 CFR 172.101, Column 3.a.

5.3.3 Principal radionuclides (greater than 1% of total activity).

5.3.4 Determine whether or not RQ (Reportable Quantity) must appear on the bill of lading per 49 CFR 173.201(a)(1)(iii).

a. Using Table 2 of Appendix to 49 CFR 172.101, determine if a single radionuclide exists as a reportable quantity.

b. If a mixture of nuclides exists, use the sum of the ratios of the quantity of a nuclide per package and the RQ for the nuclide. A package contains an RQ of a hazardous substance when the sum of the ratios is ≥ 1.

c. *If the quantities or identities of some of the nuclides* in a package are unknown, follow the instructions found in the Appendix to 49 CFR 172.101 step 6 for RQ determination.

d. If not exempted from specification marking, a package with a capacity of 110 gallons or less must have the letters RQ in association with the proper shipping name.

5.3.5 Physical and chemical form of material.

5.3.6 Net quantity (activity) in each package.

5.3.7 Category of RADIOACTIVE label applied to each package.

a. Any package requiring a RADIOACTIVE YELLOW II label must be identified on the bill of lading.

5.3.8 Transport Index for all packages labeled RADIOACTIVE YELLOW II.

5.3.9 For each shipment of radioactive material, emergency response information must be maintained during transportation and at facilities where hazardous materials are loaded for transportation or otherwise handled during any phase of transportation.

a. Emergency response information is not required for shipments of radioactive materials excepted from the shipping paper requirements of subchapter C of 49 CFR, such as those shipments designated as limited quantity.

b. Complete form, Emergency Response Information (Attachment 2) and include with the shipping papers for the radioactive material shipment.

5.4 If the package of radioactive material is to be shipped for disposal, the following are additional required steps:

5.4.1 Use form, *Radioactive Waste* Shipment Checklist (Attachment 3), ***for shipments to a disposal facility.***

5.4.2 Verify that the ***radioactive waste material*** has been classified in accordance with 32 IAC 340.1052.

5.4.3 Verify ***that the package's records meets the radwaste material*** form requirements of 32 IAC 341.1055.

5.4.4 Use Envirocare's Radioactive Waste Shipment & Disposal Record form (see Reference 2.12) as the manifest form for all shipments of radioactive ***waste material going*** to Envirocare of Utah, Inc.

5.4.5 Mail or otherwise send, separate from the shipment, a copy of the disposal site shipping manifest to the disposal facility operator. This copy of the shipping manifest may be sent the same day that the shipment leaves the site.

5.4.4.1.1 The disposal site operator is required to acknowledge receipt of the shipment within seven days of arrival by returning a signed copy of the first page of the shipping manifest (or equivalent) to the shipper.

5.4.6 Verify and document on form Radioactive Waste Shipment Checklist, (Attachment 3), that the return receipt for the shipment has been received within 20 days of shipment.
For shipments whose receipt has not been acknowledged within 20 days, initiate a trace investigation in accordance with 32 IAC 340.1060(h).

5.5 Packages shipped as "LIMITED QUANTITY" in accordance with 49 CFR 173.421, ***are excepted from*** specification packaging, package marking, labeling, ***and shipping paper requirements*** provided:

a. Package meets "strong, tight" requirements of 49 CFR 173.24.

b. Inner liner, if present, or outer packaging, if not, is marked with the word "RADIOACTIVE."

c. Package activity does not exceed $10^{-3}A_2$ for solids and gases, or $10^{-4}A_2$ for liquids.

d. Package external contamination levels do not exceed 2200 dpm/100 cm^2 ß and 220 dpm/100 cm^2 ∝.

e. Package contact radiation level ≤ 0.5 mR/hr.

f. Form, Shipment Certification (Attachment 4), is either included within each package, with the packing slip, or provided to the vehicle operator.

5.5.1 Deleted

5.5.2 If the limited quantity shipment involves an environmental sample being shipped for analysis, ensure that a copy of the Chain of Custody Record ***(ref. Kerr-McGee form #KM-4775)*** accompanies the sample being shipped.

5.6 For packages shipped by rail or highway under the "EXCLUSIVE USE" provisions of 49 CFR 173.403 (i), the following additional steps are required:

5.6.1 Verify that the certification statement of 49 CFR 172.204: "This is to certify that the above-named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulation of the Department of Transportation," appears on the shipping paper, and is signed by the Site Manager, or his ***designee***.

5.6.2 If a Radioactive Yellow II label is required, record the package contents (radionuclides), number of curies, and Transport Index (TI) on the label. Affix label to two opposite sides of the package (excluding the bottom) near the proper shipping name.

5.6.3 Verify that the radioactive material has been properly prepared, packaged, marked, labeled, and loaded on the vehicle.

5.6.4 Ensure that package radiation and contamination surveys have been performed and documented, and that package radiation and contamination levels are within the limits specified in Section 4.3.

5.6.5 Ensure that the vehicle has been completely tarped, blocked and braced, or the packaged material sufficiently restrained to preclude movement within the vehicle during normal transport.

5.6.6 Ensure that the vehicle or rail car is properly placarded per Subpart F of 49 CFR 172. If placarding is required and shipment is by vehicle, all four sides must have placards.

5.6.7 Verify that a radiation survey of the loaded vehicle has been performed and documented on Shipment Load Diagram (Attachment 5).

5.6.8 Complete Form Exclusive Use Vehicle Instructions to Carrier (Attachment 6), and have the vehicle operator read the exclusive use statement and acknowledge compliance his or her signature, and include a signed copy with the shipping papers.

5.6.9 For closed vehicles, install tamper seals on all cargo area doors and padlocks.

5.6.10 Contact the Site Manager, or his *designee*, for final inspection of the vehicle, cargo and paperwork.

5.6.11 Insure that the carrier (vehicle operator) has all the required shipment papers, and appropriate copies have been retained for the site files.

5.7 For packages shipped as other than exclusive use, ensure completion of the following:

5.7.1 Certification statement of 49 CFR 172.204: "This is to certify that the above-named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation," appears on the shipping paper and is signed by the Site Manager or his ***designee***.

5.7.2 Package external radiation level is less than 200 mR/hr contact and 10 mR/hr at one meter.

5.7.3 Package external contamination level does not exceed 2200 dpm/100 cm^2 ß and 220 dpm/100 cm^2 α.

5.7.4 If the radiation level on the external surface of the package is greater than 0.5 mR/hr and less than 50 mR/hr, and the radiation level at 1 meter is less than 1 mR/hr the package may be shipped as a Radioactive Yellow II shipment.

Ensure that the shipping container meets the DOT Specification 7A Type A general packaging requirements per 49 CFR 173.415.

5.7.5 If a Radioactive Yellow II label is required, record the package contents (radionuclides), number of curies, and TI on the label. Affix label to two opposite sides of the package (excluding the bottom) near the proper shipping name.

5.7.6 Package is marked correctly in accordance with 49 CFR 172 Subpart D.

5.7.7 Ensure vehicle radiation and contamination surveys have been performed.

5.7.8 Placarding requirements in Subpart F of 49 CFR 172 are met.

5.7.9 Final inspection of the vehicle, cargo, and paperwork is performed by Site Manager, or his ***designee***.

5.7.10 For ***radioactive*** waste shipments, the disposal facility operator is required to acknowledge receipt within one week by returning a signed copy of the manifest.

5.8 For shipments of railcars to the *disposal* facility of Envirocare of Utah, refer to ***2.15 above.***

5.9 Laundry shipments (e.g. used personnel protective equipment)

5.9.1 Used coveralls and rubber boots shall be packaged in plastic bags, at the Contamination Reduction Zone, prior to shipment. HP Technicians shall perform a radiation and loose surface contamination survey on each plastic bag.

5.9.2 The loose surface contamination level shall be less than 33dpm/100 cm² « gamma.

5.9.3 If the radiation level is equal to or less than 360 cpm the laundry is not considered radioactive and therefore can be shipped as a non-radioactive shipment. If the radiation level is greater than 360 cpm, contact the HP Supervisor to determine the way the laundry is to be shipped.

5.9.4 The HP technicians shall assist the driver in loading the truck.

5.9.5 The HP technician shall initiate a bill of lading stating that the laundry is not radioactive material but contains small amounts of thorium tailings.

5.9.6 *After the truck is loaded, the HP technician shall perform a radiological survey of the vehicle. Notify the HP Supervisor immediately of any abnormal readings / indications observed (ref. Attachment 5).*

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Shipping records shall be maintained by the Site Manager. A complete shipment record packet includes copies of all completed and signed paperwork that accompanied the shipment.

6.2 In the event that a trace investigation has been initiated per Step 5.10, the Site Manager, or his ***designee***, will file a written report with the Illinois Department of Nuclear Safety within 2 weeks after the investigation has been completed.

6.3 Anyone who observes a deficiency in complying to this procedure shall initiate a nonconformance report per WCP QPM Document #9.

7.0 ATTACHMENTS

7.1	Attachment 1	*Example Bill of Lading-Short Form (for Exclusive Use)*
	Attachment 1A	*Deleted*
7.2	Attachment 2	Form - Emergency Response Information.
7.3	Attachment 2A	Form - Emergency Procedure
7.4	Attachment 2B	Form - Evaluation Questionnaire
7.5	Attachment 3	Form - *Radioactive Waste Shipment Checklist.*
7.6	Attachment 4	Form - Shipment Certification.
7.7	Attachment 5	Form - Shipment Load Diagram - Truck.
7.8	Attachment 6	Form - Exclusive Use Vehicle Instructions To Carrier.

ATTACHMENT 1

STRAIGHT BILL OF LADING - SHORT FORM - Original - Not Negotiable

RECEIVED, subject to the contract in effect on the date of the issue of this Bill of Lading

From: KERR-McGEE CHEMICAL CORPORATION

the property described below in apparent good order, marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all terms and conditions of the contract in effect on the date of the issue of this Bill of Lading

SHIPMENT NUMBER

FULL NAME OF SHIPPER:

Kerr-McGee Chemical Corporation

CARRIER:	TRUCK #:	DATE:	FROM NO. STATION: STATE
SHIPPED FROM:	CONSIGNED TO:		

ROUTE: DELIVERING CARRIER:

This material is routed "exclusive use". The vehicle is to remain closed between origin and destination. No material may be added to the vehicle or removed from the vehicle in route.

LINE NO.	DESCRIPTION AND CLASSIFICATION	ESTIMATED QUANTITY
	(Proper Shipping Name, Reportable Quantity, if applicable/ Hazard Class) (Proper UN identification number) (Net activity in each package) (Principal Radionuclides) (Physical and chemical form of material) (Indicate Yellow II on any applicable packages)	

TRUCK SHIPMENTS: PLACARDS REQUIRED

THIS IS TO CERTIFY THAT THE ABOVE-NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED A[ND] LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF T[HE] DEPARTMENT OF TRANSPORTATION.

KERR-McGEE CHEMICAL CORPORATION PER PER

Shipper Permanent post office address of shipper,

Oklahoma City, OK 73125 AGENT

ATTACHMENT 2

KERR-MCGEE CHEMICAL CORPORATION

EMERGENCY RESPONSE INFORMATION

Shipment I.D. No. ____________________

1. Proper Shipping Name and Hazard Class
(Check (✓) one of the two types listed below)

_______ Radioactive Material, Low Specific Activity, n.o.s. - Radioactive Material UN 2912

_______ Radioactive Material, n.o.s. - Radioactive Material UN 2982

DRIVER EMERGENCY PROCEDURE

A) RESCUE and LIFESAVING may be done with little fear of the hazards from the cargo on this truck. If possible, avoid breathing dust from any spilled cargo.

DO NOT DELAY RESCUE EFFORTS!

B) After providing needed rescue, lifesaving, first aid or fire-fighting, please read the attached instructions in the event of cargo spillage.

TO THE DRIVER:

Keep these emergency procedures with your shipping papers.

By my signature I certify that I have read and understand these emergency procedures.

Driver's Signature:____

ATTACHMENT 2A
KERR-MCGEE CHEMICAL CORPORATION
EMERGENCY PROCEDURE

This vehicle contains ____________________ which are contaminated with natural thorium. In the event of an accident involving spillage of *radioactive material*, the following actions are recommended, if appropriate:

1. LIFESAVING, RESCUE AND FIREFIGHTING

   This may be done with little fear towards the hazards from the debris contaminated with thorium. If possible, avoid breathing dust and avoid swallowing it. Thorium on the skin or clothing is relatively harmless and simple washing methods will remove it. If you come into contact with the debris, please wait for advice from health officials. To avoid ingestion of thorium, do not eat, drink, or smoke while near the spill.

2. CONTACT THE LOCAL LAW ENFORCEMENT AGENCY

   Tell the police of the accident with spillage of "LOW SPECIFIC ACTIVITY" (LSA) radioactive material called natural thorium. Ask them to notify the state health department. Give them the location of the accident site and tell them of any injuries to persons.

3. Fill Out Attached Questionnaire

   Please obtain all of the information asked for on the attached form. You will need to relay this information to the carrier and the shipper.

4. Telephone the Carrier and Shipper (call collect)

   a) The Trucking Carrier is ______________________________
      Telephone No. ______________________________

   b) The Shipper is: Kerr-McGee Chemical Corporation

      Telephone No. ________________________

   Read the completed questionnaire to whomever answers your calls. It may be necessary to read the questionnaire a second time for complete understanding.

5. When Help Arrives Please cooperate with all Civil Authorities and Carriers and Shipper's personnel who arrive at the scene. Follow their health-safety instructions for checking possible contamination of your clothing or body.

   Please be assured that your exposure to this material will be relatively harmless, particularly if you have followed these instructions. The health and safety personnel who will arrive will be glad to answer any questions you have about this matter.

ATTACHMENT 2B
KERR-MCGEE CHEMICAL CORPORATION
EVALUATION QUESTIONNAIRE

1. Name of truck driver ______________________

2. Name of trucking company ______________________

3. Bill of lading number ______________________

4. Destination of shipment ______________________

5. Date and time of accident ______________________

6. Place of accident ______________________

7. Name of Police Dept. notified ______________________

8. Phone No. of Police notified ______________________

9. Is the driver injured? ____________ Others? ______________________

10. Is or was there a fire ? ______________________

11. Is the truck road worthy? ______________________

12. Are boxes off of the truck? ____________ How many? ____________

13. Estimate the number of square feet of spilled material ______________________

14. Has the spill been covered? ______________________

15. Is the spill on the ground? ____________ Pavement? ____________

16. Is the spill in water? ____________ Lake? ____________ Stream? ____________

17. Is the spill near a building? ____________ Sewer? ____________

18. Is the accident place illuminated at night? ______________________

19. Other comments: ______________________

20. Where can you be reached by phone?

    a) Near the accident site ______________________

    b) Home or business phone ______________________

    c) Your name: ______________________

ATTACHMENT 3

RADIOACTIVE WASTE SHIPMENT CHECKLIST

DATE ________________________ BY ________________________

SHIPMENT No.__________________ *CONSIGNEE* ________________

<u>NOTE</u>: Initial each statement *as being completed* or fill in the blank *with appropriate comment(s)*. N/A is acceptable for those steps not required for this particular shipment.

1. General description ______________
2. Consignee license reviewed and consignee authorized to receive type and quantity of material in shipment. ______________
3. Number of packages in shipment. (Indicate number of packages of each type of waste.) ______________
4. All containers inspected by Site Manager, or *designee*, to ensure compliance with all applicable laws, rules and regulations, including: labeling, obliteration of old markings, *rad*waste classification/stability, gross weight, and package specifications. ______________
5. A determination has been made whether or not any package in this shipment is a Reportable Quantity. ______________
6. If this is an "Exclusive Use" shipment, the packages are loaded and blocked and braced or otherwise restrained to prevent movement. ______________
7. Placard the vehicle per Subpart F of 49 CFR 172. For tractor-trailers, placard each side of the trailer and place one on the front of the tractor. For rail shipments, a placard must be visible on each side of a rail car not coupled to another car. ______________
8. If applicable, the required tamper proof seals are installed. ______________
9. *KMCC*s *Straight Bill of Lading- Short Form, (attachment 1)* has been completed. Normal copy distribution if applicable is as follows: ______________
   a. *WCP Project* files.
   b. With shipment, *Note: if radwaste material*, the copy goes in the disposal site paperwork package.
   c. With driver paperwork package.

NOTE: The following step applies to ***shipments for disposal at*** the Envirocare of Utah facility only.

10. The Envirocare of Utah facility***'s Radioactive Waste Shipment Record,*** is complete. __________

Copy distribution:

a. Original with shipment paperwork package.

b. Copy with driver paperwork package.

c. Copy to ***WCP Project*** files.

11. The "EXCLUSIVE USE" Vehicle Instructions to Carrier, ***(attachment 6),*** has been completed. __________

Copy distribution:

a. Original with drivers paperwork package.

b. Copy with shipment paperwork package.

c. Copy to ***WCP Project*** files.

12. ***Deleted***

13. Radiation surveys have been performed.

Copy distribution:

a. Original to ***WCP Project*** files.

b. Copy with driver's paperwork package.

13. Receipt of ***radwaste*** material has been acknowledged by the disposal site operator ***within allotted time (20 days).*** __________

Copy distribution:

a. Original with shipment paperwork

b. One copy with driver's paperwork

c. One copy to ***WCP Project*** files

15. Vehicle check performed. ______________

16. ***Deleted*** ______________

Reviewed by:_______________________________________***Date***_________
Site Manager or Designee

ATTACHMENT 4

SHIPMENT CERTIFICATION

Shipment # ________________

THIS PACKAGE CONFORMS TO THE CONDITIONS AND LIMITATIONS SPECIFIED IN 49 CFR 173.421 FOR RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - LIMITED QUANTITY OF MATERIAL, N.O.S., UN 2910.

____

Signature/Date
KERR-MCGEE CHEMICAL CORPORATION
WEST CHICAGO, ILLINOIS

ATTACHMENT 5
KERR-McGee CHEMICAL CORPORATION
WEST CHICAGO FACILITY

SHIPMENT LOAD DIAGRAM - TRUCK

SHIPPER	CAB NUMBER	TRAILER NUMBER
SURVEY BY	SHIPMENT NO.	DATE

TRUCK CHECKED FOR CONTAMINATION:

BEFORE LOADING: ☐ <2200 dpm/100 cm^2 beta-gamma ☐ <220 dpm/100 cm^2 alpha

☐ CONTAMINATED TO

RADIATION LEVEL, MR/hr	CONTAMINATION LOCATION

AFTER LOADING: ☐ <2200 dpm/100 cm^2 beta-gamma ☐ <220 dpm/100 cm^2 alpha

Front of Van

Surface ____________ mR/hr

6' ____________ mR/hr

Left Side

Surface ____________ mR/hr

6' ____________ mR/hr

Right Side

Surface ____________ mR/hr

6' ____________ mR/hr

Top of Truck

Surface ____________ mR/hr

6' ____________ mR/hr

Under Truck

Surface ____________ mR/hr

Rear Surface ____________ mR/hr

6' ____________ mR/hr

ATTACHMENT 6
KERR-MCGEE CHEMICAL CORPORATION
"EXCLUSIVE USE" VEHICLE INSTRUCTIONS TO CARRIER

SHIPMENT NO.____________________ DATE ______________________

1. This shipment of radioactive material is being transported as an EXCLUSIVE USE shipment, loaded by Kerr-McGee Chemical Corporation (the consignor) and may only be unloaded under the direction of the consignor or consignee [49 CFR 173.403 (i)].

2. Any removal, addition to, or movement of, any material in this shipment by anyone, except under the direction of the consignee or consignor, shall constitute a violation of federal law.

3. A closed van shipment shall not be opened, nor shall any shipment be changed or modified in any manner, except by the consignee, without the prior authorization of Kerr-McGee Chemical Corporation. No change of tractor is authorized without prior approval of Kerr-McGee Chemical Corporation. Do not move the 5th wheel of the tractor once the shipment has left the Kerr-McGee West Chicago site.

In the event of an emergency, accident, or contemplated deviation from any of the above instructions, notify Kerr-McGee Chemical Corporation at: ( )____-________. Routine inspection of placarding is required at all "off the road" stops.

Kerr-McGee Chemical Corporation Authorization

____

Signature Date

CARRIER ACKNOWLEDGEMENT:

I have read and understand the foregoing instructions. I agree that this shipment will be made in full accordance with these *instructions.*

____

Signature Date

____

Print Name

LINDSAY LIGHT II SITE

Standard Operating Procedure

Title: Surveys for Surface Contamination and Release of Equipment for Unrestricted Use

Document Number: SOP-LLII345

Revision Number: 0

Approved By: gow

Date: October 23, 1996 **Replaces:** None

INTERIM CHANGE FORM

Change No. LLII - 029

Document No. 203
Section No. REF-SOPs, Appd. C
Page No. 2
Revision No. 0

Requirement:	LLII Scoping and Planning Document #203, Section REF-SOPs, Appendix C SOP-LLII 345
Change:	Incorporate current revision of REF-SOP 345. Ref. WCP 345-3
Effective Date:	5/5/97
Approval:	

[signature] 5/7/97

OFFSITE PROJECT MANAGER DATE

SURVEYS FOR SURFACE CONTAMINATION AND RELEASE OF EQUIPMENT FOR UNRESTRICTED USE

Reviewed By: ______________________________ Date: ____________
Quality Assurance Supervisor

Reviewed By: ______________________________ Date: ____________
Site Manager

Reviewed By: ______________________________ Date: ____________
Project Manager

SURVEYS FOR SURFACE CONTAMINATION AND RELEASE OF EQUIPMENT FOR UNRESTRICTED USE

1.0 SCOPE

1.1 Purpose

This procedure provides the methods for the detection and measurement of radioactive contamination within the site areas, it provides the methods for evaluating contamination, and establishes the criteria for releasing equipment or materials out of the Exclusion Zone. These methods are to be used to minimize the spread of radioactive contamination.

1.2 Applicability

This procedure applies to surveys that are performed on building surfaces, vehicles, equipment, materials (herein referred to as equipment) at the site and to the site personnel, who are required to monitor and release the equipment.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 NUREG CR5849 Manual for Conducting Radiological Surveys in Support of License Termination

2.5 State of Illinois Department of Nuclear Safety License Number STA-583

3.0 DEFINITIONS

3.1 Beta-Gamma to Alpha Decay Ratio

A thorium-232 decay series produces about 0.5 beta-gamma decays for every one alpha decay. This ratio allows the limits for alpha contamination to be verified using beta-gamma survey instruments.

3.2 Clean Area

This term defines radiation conditions within a specified area. An area where the radiation levels and contamination levels are maintained below 2 mrem/hr and 33 dpm/100 cm^2 alpha respectively.

3.3 Contamination Surveys

An assessment that may include, as appropriate, surveys for loose and fixed contamination through the use of direct frisks, large area wipes and smears, to locate and quantify the radioactive material present.

3.4 Exclusion Zone

The area on one side of the Control Line that includes Contamination Control Areas, Radiation Areas, and Airborne Radioactivity Areas.

3.5 Large Area Wipes

Paper towels or maaslin used to wipe large areas to identify the presence of loose contamination.

3.6 Lower Limit of Detection (LLD)

The smallest amount of a radionuclide in a sample that will be detected with a probability of non-detection (Type 1 error) while accepting a probability of erroneously detecting that radionuclide in a blank sample (Type II error). These probabilities are 0.05 (5% chance of Type I or II errors). See Attachment 5 - "LLD Calculation" sheet.

3.7 Smears

Typically 2 inch disk type paper material. Smears are normally taken to identify and quantify loose contamination.

3.8 Unrestricted Release

Release of equipment or materials from the Exclusion Zone to any destination other than a licensed facility.

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 Health Physics personnel shall ensure that all portable survey equipment used fo this procedure are properly functioning and have a valid calibration sticker.

4.1.2 The Health Physics Supervisor or designee shall ensure that all personnel who are required to perform this procedure are properly trained and understand this procedure.

4.1.3 Equipment, vehicles and areas should be free of visible dirt, mud or dust prior to performing a contamination survey.

4.2 Tools, Material, Equipment

4.2.1 The following counting equipment, or their equivalents, should be used for performing contamination surveys on equipment and materials:

- Eberline PAC-4G gas proportional survey meter coupled to an AC-21 probe or equivalent.
- Eberline PRM6 rate meter coupled to an HP-210 shielded GM detector or equivalent.
- Gamma Products G5000 automatic alpha/beta counting system or equivalent.
- Eberline E-530 survey meter with an HP-270 tissue equivalent GM detector or equivalent.
- Eberline RD-14 Alpha counting system or equivalent.

4.2.2 Survey Maps (or lists) should be produced for each applicable type of equipment. Sketches of building surfaees (walls, floors, etc.), identifying the surveyed grids, should be produced for each surveyed building.

4.3 Precautions, Limits

4.3.1 Direct and removable surveys should not be performed on wet surfaces, for alpha contamination. Wet surfaces should be surveyed only for beta-gamma contamination. ***However,*** the Health Physics Supervisor shall make the final determination as to when a wet surface is to be surveyed.

4.4 Acceptance Criteria

4.4.1 Prior to unrestricted release from the Exclusion Zone, all vehicles, equipment and materials shall be surveyed for contamination. If contamination is found, then the vehicle, equipment, or material should be decontaminated in order to be within the applicable surface contamination release limits per Attachment #3 ***and Attachment 6 (Beta-Gamma Survey of Truck Tires) shall be used as a guideline for meeting Department of Transportation (49CFR173.443) release criteria when performing surveys on wet surfaces.***

4.4.2 The release of items from clean areas within the Exclusion Zone will be controlled by specific criteria established on a case by case basis and approved by the Health Physics Supervisor.

5.0 PROCEDURE

5.1 Routine Surface Contamination Surveys

5.1.1 Routine surveys shall be performed by trained personnel (typically by Health Physics Technicians), in accordance with this procedure and as scheduled by theHealth Physics Supervisor.

5.1.2 Routine contamination surveys are not required in the Exclusion Zone.

5.1.3 Support Zone and Contamination Reduction Zone shall be surveyed at least weekly to ensure that cross contamination is not occurring. The clean side of the Contamination Reduction Zone should be surveyed each work day.

5.1.4 Other surveys will be performed, as appropriate, to support Special Work Permits, the movement of equipment from radioactive material areas to clean areas, and to evaluate radiological conditions in specific work areas when directed by the Health Physics Supervisor.

5.2 Support/ Contamination Reduction Zone- Surface Contamination Surveys

5.2.1 Survey techniques may employ the use of large area wipes, smears, or direct frisks as appropriate to the area being surveyed.

5.2.2. Large area wipes may be used to assess floor areas for contamination. A sufficient number of large area wipes should be used to evaluate approximately 10% of the floor area being surveyed.

5.2.3 If contamination is found with the large area wipes, a more detailed smear survey should be performed.

5.2.4 Counter tops, office furniture, laboratory equipment, etc., should be included in the contamination surveys. The area immediately on the clean side of the Control Line should be included in the survey.

5.2.5 Smears shall cover approximately 100 cm^2 and should focus on areas with the highest potential for removable contamination. The smears should be placed in an envelope that is labeled with a sequential number corresponding to the Smear Number on the "Radiological Survey Data Sheet -West Chicago Facility" (see Attachment 1).

5.2.6 The smears shall be analyzed for alpha contamination.

5.3 Equipment- Surface Contamination Surveys

5.3.1 Equipment shall be surveyed for contamination by using large area wipes, smears and by direct frisk as appropriate.

5.3.2 Take an appropriate number of smears to adequately assess the radiological conditions of the item being surveyed.

5.3.3 A large area wipe may be used as an indication of the presence of contamination.

5.3.4 Smears shall cover approximately 100 cm^2 and should focus on areas with the highest potential for removable contamination. The smears should be placed in an envelope that is labeled with a sequencial number corresponding to the Smear Number on the "Radiological Survey Data Sheet -West Chicago Facility" (see Attachment 1).

5.3.5 The smears shall be analyzed for alpha contamination.

5.4 Unrestricted Release

5.4.1 Materials, equipment and vehicles shall be surveyed for contamination prior to unrestricted release from the site, using large area wipes, smears, and by direct frisk.

5.4.2 All building surfaces, large concrete pieces, and other materials having large, smooth surfaces shall be surveyed prior to unrestricted release. A sufficient number of large area wipes and/or smears shall be taken to adequately assess any contamination present.

5.4.3 All equipment intended for unrestricted release from contaminated areas shall be surveyed for removable and fixed contamination. A sufficient number of large area wipes and/or smears shall be taken to adequately assess any contamination present. If removable contamination is within the release criteria, then perform a direct alpha frisk. Particular attention should be given to areas of the vehicle most likely to have become contaminated such as tire exterior surfaces, occupied areas, load areas, wheel wells, and the bottom of the equipment.

5.4.4 Vehicles intended for unrestricted release from contaminated areas shall be surveyed for removable contamination with large area wipes. If no contamination is found, take a confirmatory smear to document each large area wipe. If contamination is found, take an appropriate number of smears to evaluate the removable contamination present. If removable contamination is within the release criteria, then perform a direct alpha frisk. All survey results must be documented.

5.4.5 Vehicles intended for unrestricted release from clean areas in the Exclusion Zone shall be surveyed with large area wipes on accessible tire/track surfaces, with a direct frisk of tire/track surfaces, and with <u>one smear each for two tires.</u> The results of the direct frisk and the large area wipes must indicate that the release criteria is met. The smears shall be added to the survey documentation when the results become available.

5.4.6 Large area wipes may be used as an indication of the presence of contamination.

5.4.7 If no contamination is found with a large area wipe, a confirmatory smear shall be taken for documentation.

5.4.8 If contamination is found with the large area wipe, a representative number of smears shall be taken to quantify the removable contamination present.

5.4.9 Smears shall cover approximately 100 cm^2 and should focus on areas with the highest potential for removable contamination. The smears should be placed in an envelope that is labeled with a sequencial number corresponding to the Smear Number on the "Radiological Survey Data Sheet-West Chicago Facility" (see Attachment 1).

5.4.10 The smears shall be transported to the - Site Laboratory for analysis.

5.4.11 Perform a direct frisk on all material being surveyed for unrestricted release.

5.4.12 Personal equipment and articles (radios, pens, paper, clipboards, etc.) can be surveyed with either the large area wipes or by direct frisk, as appropriate.

> **NOTE**
> Items that have irregular surfaces, such as radios, should be wiped and frisked. Items with relatively smooth surfaces, such as paper, pens, etc., may be direct frisked only.

5.5 Documentation of Results

5.5.1 The smear counting results and data shall be documented on the "Radiological Survey Data Sheet-West Chicago Facility" (see Attachment 1). The documentation of the release survey shall include a drawing of the item to be released.

5.5.2 The instructions for completion of the Radiological Survey Data Sheet are contained in Attachment 2.

5.5.3 A request for equipment release form (Attachment 7) shall be initiated by the equipment owner to track the decontamination process.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 The Health Physics Supervisor and the Site Manager (RSO) shall review and approve all completed survey forms required by this procedure, to comply with reference 2.5 above.

6.2 The survey maps shall be uniquely numbered and retained by Health Physics for project filing. Single item survey maps shall be attached to the survey results.

7.0 ATTACHMENTS

7.1	Attachment 1	Radiological Survey Data Sheet -West Chicago Facility(example)
7.2	Attachment 2	Radiological Survey Data Sheet Instructions (2 pages)
7.3	Attachment 3	Surface Contamination Release Limits
7.4	Attachment 4	Large Area Wipes on Truck Tires
7.5	Attachment 5	LLD Calculation
7.6	Attachment 6	Beta- Gamma survey of Truck Tires (wet surfaces)
7.7	Attachment 7	Request For Equipment Release

Attachment 1

RADIOLOGICAL SURVEY DATA SHEET - WEST CHICAGO FACILITY

PAGE	OF

	00 ___ Vehicle	98 ___ Equipment	___ ___ Building	99 ___ Other
ITEM DESCRIPTION				

REFERENCE #	YR	MO	DAY	ITEM	NO.	PERFORMED BY
ALPHA SURVEY INSTRUMENTATION					BETA SURVEY INSTRUMENTATION	

LOCATION	SMEAR NUMBER	ALPHA ACTIVITY (dpm/100cm²)			BETA-GAMMA DIRECT (CPM)
		DIRECT	REMOVABLE	FIXED	

REMARKS

REVIEWED BY:	DATE:

Attachment 2

RADIOLOGICAL SURVEY DATA SHEET INSTRUCTIONS

1. Select the appropriate survey category.

2. Enter the purpose of the survey in the "ITEM DESCRIPTION" section. Be specific:

   - Vehicle survey for release from the site.

   - Tools and equipment for use in the clean area.

   - SWP support, include the SWP number.

3. Enter the survey date.

4. Enter the reference number - Year, Month, Date, Item (Use coding for categories at the top of the form) and Number (Individual survey number issued to each technician by Kerr-McGee).

5. Enter your signature in the "PERFORMED BY" section.

6. Enter the instrument(s), serial number(s), and background reading(s) for the survey instruments used for this survey.

7. Enter the "LOCATION OF READING." Enter descriptions such as, the location and item being surveyed, vehicle number, smear location on vehicle, etc.

8. Enter the number of the smear or large area wipe in the "SMEAR NUMBER" section.

9. All data in the "ALPHA ACTIVITY" section is recorded in dpm/100cm^2, except large area wipe data.

   - If equipment/material is directly frisked, the reading from the PAC-4G is converted to dpm/100cm^2 by multiplying ccpm by a factor of 4 (Gross cpm - Background cpm X 4) and enter the result in the "DIRECT" column. If the instrument response cannot be distinguished from background enter <200 dpm/100cm^2.

Attachment 2 (Cont.)

RADIOLOGICAL SURVEY DATA SHEET INSTRUCTIONS

- The "REMOVABLE" column may contain the result from a smear or the result from a large area wipe. Smear results that are less than the LLD shall be recorded as less than the numerical LLD value for the instrument in use. As an example, if the LLD for the G5000 is 3 dpm, then the result will should be recorded as <3 dpm/100cm^2. All results should be rounded to the nearest whole number. Results from LAWS should be recorded as dpm without regard to area, unless specific instructions are given to calculate the result per area, as in Attachment 4. Results that do not exceed background should be recorded as BKG (Background).

- Fixed contamination is the difference between the direct frisk results and the removable contamination results. If no fixed contamination is detectable, enter N/A in the "FIXED" column.

10. If a "BETA-GAMMA DIRECT" survey is performed, record the results as ccpm.

11. In the "REMARKS" section, record any identifying data on counting equipment and any other information needed for explanation or interpretation of survey data. If large area wipes are included in the removable contamination data without regard to area, note this in the "REMARKS" section.

Attachment 3

SURFACE CONTAMINATION RELEASE LIMITS

Average Removable (dpm/100 cm²)	Maximum Removable (dpm/100 cm²)	Average Fixed (dpm/100 cm²)	Maximum Fixed (dpm/100 cm²)
33	100	1,000	5,000
Equivalent Beta-Gamma Measurements[b,c]			
17	50	500	2,500

[a] The contamination levels may be averaged over one (1) square meter provided the maximum activity per any 100 cm² area within the one (1) square meter is less than the maximum applicable release limit.

[b] Beta-gamma release limits derived from the beta-gamma to alpha ratio.

[c] Beta-gamma surveys are not normally performed for release purposes. If alpha contamination is verified to be within specified release limits, the alpha to beta-gamma ratio indicates that the beta-gamma is also within limits.

Beta-gamma frisks may be used as appropriate to:

- Estimate contamination levels prior to performing release surveys.
- Estimate levels of contamination present on equipment, materials and work areas.

The results of direct beta-gamma frisks should be quantified on survey records as CCPM (Corrected Counts Per Minute).

Results that are less than 100 CCPM should be recorded on the survey record as <100 CCPM.

Attachment 4

LARGE AREA WIPES ON TRUCK TIRES

Large area wipes are used to wipe an area of approximately 2000 cm^2 on truck tires. The wipes are then frisked with a PAC-4G.

Assuming that 50 cpm above background is readable, it can be assumed that 100 dpm is detectable on a wipe. If the area of the wipe requires two probe areas to cover the wipe, then it can be assumed that we can assess with each measurement approximately half of the total area wiped, or 1000 cm^2, or approximately 100 dpm/1000 cm^2, which is equivalent to 10 dpm/100cm^2.

Frisk results on LAWs, from truck tires, that are nondetectable may be recorded as <10 dpm/100cm^2 in the removable column of the survey report.

ATTACHMENT 5

LLD CALCULATION

$$LLD = \frac{2.71}{T_s} + 3.29\sqrt{\left(\frac{C_b}{T_b}\right)\left(1 + \frac{T_b}{T_s}\right)}$$

Where C_b = Background Counts Per Minute
T_b = Background Counting Time in minutes
T_s = Sample Counting Time in minutes

EXAMPLE: The background count rate for a given counter is 1.56 cpm over a 50 minute counting time and samples are counted for 2 minutes. The counter has an efficiency of 40.3%.

$$LLD = \frac{2.71}{2} + 3.29\sqrt{\left(\frac{1.56}{50}\right)\left(1 + \frac{50}{2}\right)}$$

$$LLD = 4.32\ cpm$$

$$LLD = \frac{4.32\,cpm}{.403} = 10.7\,dpm$$

ATTACHMENT 6

Beta-Gamma Survey of Truck Tires

The *Department of Transportation* removable contamination limits ***in 49CFR 173.443*** are 220 dpm alpha contamination and 2200 dpm beta contamination. The most restrictive is the alpha limit. If weather prevents surveying for alpha contamination, then beta-gamma surveys will have to be utilized. The alpha to beta ratio ***for the thorium chain is approximately 2:1. Using an alpha*** to beta ratio of 2, the beta equivalent activity for the alpha limit would equal 110 dpm. 110 dpm times the probe efficiency of 0.14 cpm/dpm equals 15.7 cpm. 15.7 cpm above background is not discernable in the field. The diameter of a truck tire is 43 inches. The tread width is 9 inches. The surface area of a truck tire equals 7843.8 cm^2. Approximately 12 inches of tread is on the ground and not surveyable. This represents 3.5% of the surface area of the tire. The remaining 96.5% equals a surface area of 7569.5 cm^2. The typical area of contact for a wipe is about 3.5 inches by 4 inches. This is equal to about 90 cm^2. If the conservative area of 100 cm^2 is used the each cm^2 of wipe is equal to 57.7 cm^2 of tread area. The manufacturer lists the surface area of the probe face as 15.5 cm^2. The tread area survey under the probe equals 894.4 cm^2. To correct the measured counts to an activity/100 cm^2 the counts indicated on the meter face must be multiplied by 8.9. If 15.7 cpm/100 cm^2 beta-gamma activity equals 220 dpm/100 cm^2 alpha contamination then the measured cpm when surveying a wipe would equal 139 cpm. The manufacturer recommends limiting the background count rate to less than 300 cpm in order to see 100 cpm above background. Due to the changing background conditions this value is being reduced to 200 cpm. Therefore if background is 200 cpm or less and the wipe on a truck tire reads less than 100 cpm above background the truck tire has less than 220 dpm/100 cm^2 removable alpha contamination.

ATTACHMENT 7
REQUEST FOR EQUIPMENT RELEASE

FROM:_______________________________ **DATE:**____________

TO: HEALTH PHYSICS SUPERVISOR

1. Equipment type & ID #_:_______________________________________

2. Usage history (locations on site):_______________________________

____

____

____

3. Scheduled date to start decontamination: ___________________________

4. HP check for survey readiness:: Technician:__________ **date:**__________

5. Equipment ready for survey: YES:___________ **NO:**______________

Actions required: _______________________________________

____

____

6.Date & Time ready for survey: ___________________________________

7. Survey date & time: _______________________________________

results: Pass:___________________ **fail:**___________________

8. equipment release date: _______________________________________

9.Approved for release: HP supervisor:__________________**date:**_______

NOTE; On large earth moving equipment, substantial cleaning may be required prior to HP checking for survey readiness. Once vehicle has been checked and is ready for release survey, it may take as much as 24 hours from the time the survey is initiated until survey results are available. If fixed or removal is located,additional decontamination and surveys are required.

SURVEYS FOR SURFACE CONTAMINATION AND RELEASE OF EQUIPMENT FOR UNRESTRICTED USE

1.0 SCOPE

1.1 Purpose

This procedure ***provides*** the methods for the detection and measurement of radioactive contamination within the site areas, ***it provides*** the methods for evaluating contamination, and establishes the criteria for releasing equipment or materials out of the Exclusion Zone. These ***methods are to be used*** to minimize the spread of radioactive contamination.

1.2 Applicability

This procedure applies to surveys that are performed on building surfaces, vehicles, equipment, materials (herein referred to as equipment) at the site and to the ***site*** personnel, who are required to monitor and release the equipment.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 NUREG CR5849 Manual for Conducting Radiological Surveys in Support of License Termination

2.5 State of Illinois Department of Nuclear Safety License Number STA-583

3.0 DEFINITIONS

3.1 Beta-Gamma to Alpha Decay Ratio

A thorium-232 decay series produces about 0.5 beta-gamma decays for every one alpha decay. This ratio allows the limits for alpha contamination to be verified using beta-gamma survey instruments.

3.2 Clean Area

This term defines radiation conditions within a specified area. An area where the radiation levels and contamination levels are maintained below 2 mrem/hr and 33 dpm/100 cm^2 alpha respectively.

3.3 Contamination Surveys

An assessment that may include, as appropriate, surveys for loose and fixed contamination through the use of direct frisks, large area wipes and smears, to locate and quantify the radioactive material present.

3.4 Exclusion Zone

The area on one side of the Control Line that includes Contamination Control Areas, Radiation Areas, and Airborne Radioactivity Areas.

3.5 Large Area Wipes

Paper towels or maaslin used to wipe large areas to identify the presence of loose contamination.

3.6 Lower Limit of Detection (LLD)

The smallest amount of a radionuclide in a sample that will be detected with a probability of non-detection (Type 1 error) while accepting a probability of erroneously detecting that radionuclide in a blank sample (Type II error). These probabilities are 0.05 (5% chance of Type I or II errors). See Attachment 5 - ***"LLD Calculation" sheet.***

3.7 Smears

Typically 2 inch disk type paper material. Smears are normally taken to identify and quantify loose contamination.

3.8 Unrestricted Release

Release of equipment or materials from the Exclusion Zone to any destination other than a licensed facility.

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 Health Physics personnel shall ensure that all portable survey equipment used for this procedure are properly functioning and have a valid calibration sticker.

4.1.2 *The Health* Physics Supervisor or designee shall ensure that all personnel who are required to perform this procedure are properly trained and understand this procedure.

4.1.3 Equipment, vehicles and areas should be free of visible dirt, mud or dust prior to performing a contamination survey.

4.2 Tools, Material, Equipment

4.2.1 The following counting equipment, or their equivalents, should be used for performing contamination surveys on equipment and materials:

- Eberline PAC-4G gas proportional survey meter coupled to an AC-21 probe or equivalent.
- Eberline PRM6 rate meter coupled to an HP-210 shielded GM detector or equivalent.
- Gamma Products G5000 automatic alpha/beta counting system or equivalent.
- Eberline E-530 survey meter with an HP-270 tissue equivalent GM detector or equivalent.
- Eberline RD-14 Alpha counting system or equivalent.

4.2.2 Survey Maps (or lists) should be produced for each applicable type of equipment. Sketches of building surfaces (walls, floors, etc.), identifying the surveyed grids, should be produced for each surveyed building.

4.3 Precautions, Limits

4.3.1 Direct and removable surveys should not be performed on wet surfaces, for alpha contamination. Wet surfaces should be surveyed only for beta-gamma contamination. ***The Health Physics Supervisor shall make the final determination as to when a wet surface is to be surveyed. Attachment 6 (Beta-Gamma Survey of Truck Tires) shall be used as a guideline for release criteria, when performing surveys on wet surfaces.***

4.4 Acceptance Criteria

4.4.1 Prior to unrestricted release from the Exclusion Zone, all vehicles, equipment and materials shall be surveyed for contamination. If contamination is found, then the vehicle, equipment, or material should be decontaminated in order to be within the applicable ***surface*** contamination release limits ***per Attachment #3.***

4.4.2 The release of items from clean areas within the Exclusion Zone will be controlled by specific criteria established on a case by case basis and approved by the ***Health*** Physics Supervisor.

5.0 PROCEDURE

5.1 Routine *Surface* Contamination Surveys

5.1.1 Routine surveys shall be performed ***by trained personnel (typically by Health Physics Technicians),*** in accordance with ***this procedure and as*** schedule*d* by theHealth Physics Supervisor.

5.1.2 ***Routine contamination surveys are not required in the Exclusion Zone.***

5.1.3 Support ***Zone and Contamination Reduction Zone*** shall be surveyed at least weekly to ensure that cross contamination is not occurring. The clean side of ***the Contamination Reduction Zone*** should be surveyed each work day.

5.1.4 Other surveys will be performed, as appropriate, to support Special Work Permits, the movement of equipment from radioactive material areas to clean areas, and to evaluate radiological conditions in specific work areas when directed by the ***Health Physics*** Supervisor.

5.2 *Support/ Contamination Reduction Zone- Surface Contamination Surveys*

5.2.1 Survey techniques may employ the use of large area wipes, smears, or direct frisks as appropriate to the area being surveyed.

5.2.2. Large area wipes may be used to assess floor areas for contamination. A sufficient number of large area wipes should be used to evaluate approximately 10% of the floor area being surveyed.

5.2.3 If contamination is found with the large area wipes, a more detailed smear survey should be performed.

5.2.4 Counter tops, office furniture, laboratory equipment, etc., should be included in the contamination surveys. The area immediately on the clean side of the Control Line should be included in the survey.

5.2.5 Smears shall cover approximately 100 cm^2 and should focus on areas with the highest potential for removable contamination. The smears should be placed in an envelope that is labeled with a ***sequential*** number corresponding to the ***Smear*** Number on the "Radiological Survey Data Sheet ***-West Chicago Facility" (see Attachment 1).***

5.2.6 The smears shall be analyzed for alpha contamination.

5.2.6 The smears shall be analyzed for alpha contamination.

5.3 Equipment- ***Surface Contamination*** Surveys

5.3.1 Equipment shall be surveyed for contamination by using large area wipes, smears and by direct frisk as appropriate.

5.3.2 Take an appropriate number of smears to adequately assess the radiological conditions of the item being surveyed.

5.3.3 A large area wipe may be used as an indication of the presence of contamination.

5.3.4 Smears shall cover approximately 100 cm^2 and should focus on areas with the highest potential for removable contamination. The smears should be placed in an envelope that is labeled with a ***sequencial*** number corresponding to the ***Smear*** Number on the "Radiological Survey Data Sheet ***-West Chicago Facility" (see Attachment 1).***

5.3.5 The smears shall be analyzed for alpha contamination.

5.4 ***Unrestricted Release***

5.4.1 Materials, equipment and vehicles shall be surveyed for contamination prior to unrestricted release from the site, using large area wipes, smears, and by direct frisk.

5.4.2 All building surfaces, large concrete pieces, and other materials having large, smooth surfaces shall be surveyed ***prior to unrestricted release***. A sufficient number of large area wipes and/or smears shall be taken to adequately assess any contamination ***present.***

5.4.3 All equipment intended for unrestricted release ***from contaminated areas*** shall be surveyed for removable and fixed contamination. A sufficient number of large area wipes and/or smears shall be taken to adequately assess any contamination ***present.*** If removable contamination is within the release criteria, then perform a direct alpha frisk. Particular attention should be given to areas of the vehicle most likely to have become contaminated such as tire exterior surfaces, occupied areas, load areas, wheel wells, and the bottom of the ***equipment.***

5.4.4 Vehicles intended for unrestricted release ***from*** contaminated areas shall be surveyed for removable contamination with large area wipes. If no contamination is found, take a confirmatory smear to document each large area wipe. If contamination is found, take an appropriate number of smears to evaluate the removable contamination present. If removable contamination is within the release criteria, then perform a direct alpha frisk. All survey results must be ***documented.***

5.4.5 Vehicles intended for unrestricted release *from* clean areas in the Exclusion Zone shall be surveyed with large area wipes on accessible tire/track surfaces, with a direct frisk of tire/track surfaces, and with one smear each for two tires. The results of the direct frisk and the large area wipes must indicate that the release criteria is met. The smears shall be added to the survey documentation when the results become available.

5.4.6 Large area wipes may be used as an indication of the presence of contamination.

5.4.7 If no contamination is found with a large area wipe, a confirmatory smear shall be taken for documentation.

5.4.8 If contamination is found with the large area wipe, a representative number of smears shall be taken to quantify the removable contamination present.

5.4.9 Smears shall cover approximately 100 cm^2 and should focus on areas with the highest potential for removable contamination. The smears should be placed in an envelope that is labeled with a ***sequencial*** number corresponding to the ***Smear*** Number on the "Radiological Survey Data Sheet-***West Chicago Facility" (see Attachment 1).***

5.4.10 The smears shall be transported to the *Site* Laboratory for analysis.

5.4.11 Perform a direct frisk on all material being surveyed for unrestricted release.

5.4.12 Personal equipment and articles (radios, pens, paper, clipboards, etc.) can be surveyed with either the large area wipes or by direct frisk, as appropriate.

> **NOTE**
> Items that have irregular surfaces, such as radios, should be wiped and frisked. Items with relatively smooth surfaces, such as paper, pens, etc., may be direct frisked only.

5.5 Documentation of Results

5.5.1 The smear counting results and data shall be documented on the "Radiological Survey Data Sheet-***West Chicago Facility" (see Attachment 1).*** The documentation of the release survey shall include a drawing of the item to be released.

5.5.2 The instructions for completion of the Radiological Survey Data Sheet are contained in Attachment 2.

5.5.3 A request for equipment release form (Attachment 7) shall be initiated by the

equipment owner to track the decontamination process.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 The *Health Physics* Supervisor ***and the Site Manager (RSO)*** shall review and approve all completed ***survey*** forms required by this procedure, ***to comply with reference 2.5 above.***

6.2 The survey maps shall be uniquely numbered and retained ***by Health Physics for project filing.*** Single item survey maps shall be attached to the survey results.

7.0 ATTACHMENTS

7.1	Attachment 1	Radiological Survey Data Sheet *-**West Chicago Facility(example)***
7.2	Attachment 2	Radiological Survey Data Sheet Instructions ***(2 pages)***
7.3	Attachment 3	Surface Contamination Release Limits
7.4	Attachment 4	Large Area Wipes on Truck Tires
7.5	Attachment 5	LLD Calculation
7.6	*Attachment 6*	***Beta- Gamma survey of Truck Tires (wet surfaces)***
7.7	*Attachment 7*	***Request For Equipment Release***

Attachment 1

RADIOLOGICAL SURVEY DATA SHEET - WEST CHICAGO FACILITY

PAGE	OF

	00 ___ Vehicle	98 ___ Equipment	___ ___ Building	99 ___ Other
ITEM DESCRIPTION				

REFERENCE #	YR	MO	DAY	ITEM	NO.	PERFORMED BY
ALPHA SURVEY INSTRUMENTATION					BETA SURVEY INSTRUMENTATION	

LOCATION	SMEAR NUMBER	ALPHA ACTIVITY (dpm/100cm²)			BETA-GAMMA DIRECT (CPM)
		DIRECT	REMOVABLE	FIXED	

REMARKS ______________________________

____

____

REVIEWED BY: ______________________ DATE: ______________

Attachment 2

RADIOLOGICAL SURVEY DATA SHEET INSTRUCTIONS

1. Select the appropriate survey category.

2. Enter the purpose of the survey in the "ITEM DESCRIPTION" section. Be specific:

   - Vehicle survey for release from the site.

   - Tools and equipment for use in the clean area.

   - SWP support, include the SWP number.

3. Enter the survey date.

4. Enter the reference number - Year, Month, Date, Item (Use coding for categories at the top of the form) and Number (Individual survey number issued to each technician by Kerr-McGee).

5. Enter your signature in the "PERFORMED BY" section.

6. Enter the instrument(s), serial number(s), and background reading(s) for the survey instruments used for this survey.

7. Enter the "LOCATION OF READING." Enter descriptions such as, the location and item being surveyed, vehicle number, smear location on vehicle, etc.

8. Enter the number of the smear or large area wipe in the "SMEAR NUMBER" section.

9. All data in the "ALPHA ACTIVITY" section is recorded in dpm/100cm^2, except large area wipe data.

   - If equipment/material is directly frisked, the reading from the PAC-4G is converted to dpm/100cm^2 by multiplying ccpm by a factor of 4 (Gross cpm - Background cpm X 4) and enter the result in the "DIRECT" column. If the instrument response cannot be distinguished from background enter <200 dpm/100cm^2.

Attachment 2 (Cont.)

RADIOLOGICAL SURVEY DATA SHEET INSTRUCTIONS

- The "REMOVABLE" column may contain the result from a smear or the result from a large area wipe. Smear results that are less than the LLD shall be recorded as less than the numerical LLD value for the instrument in use. As an example, if the LLD for the G5000 is 3 dpm, then the result will should be recorded as <3 dpm/100cm^2. All results should be rounded to the nearest whole number. Results from LAWS should be recorded as dpm without regard to area, unless specific instructions are given to calculate the result per area, as in Attachment 4. Results that do not exceed background should be recorded as BKG (Background).

- Fixed contamination is the difference between the direct frisk results and the removable contamination results. If no fixed contamination is detectable, enter N/A in the "FIXED" column.

10. If a "BETA-GAMMA DIRECT" survey is performed, record the results as ccpm.

11. In the "REMARKS" section, record any identifying data on counting equipment and any other information needed for explanation or interpretation of survey data. If large area wipes are included in the removable contamination data without regard to area, note this in the "REMARKS" section.

Attachment 3

SURFACE CONTAMINATION RELEASE LIMITS

Average[a] Removable (dpm/100 cm^2)	Maximum Removable (dpm/100 cm^2)	Average[a] Fixed (dpm/100 cm^2)	Maximum Fixed (dpm/100 cm^2)
33	100	1,000	5,000
Equivalent Beta-Gamma Measurements[b,c]			
17	50	500	2,500

[a] The contamination levels may be averaged over one (1) square meter provided the maximum activity per any 100 cm^2 area within the one (1) square meter is less than the maximum applicable release limit.

[b] Beta-gamma release limits derived from the beta-gamma to alpha ratio.

[c] Beta-gamma surveys are not normally performed for release purposes. If alpha contamination is verified to be within specified release limits, the alpha to beta-gamma ratio indicates that the beta-gamma is also within limits.

Beta-gamma frisks may be used as appropriate to:

- Estimate contamination levels prior to performing release surveys.
- Estimate levels of contamination present on equipment, materials and work areas.

The results of direct beta-gamma frisks should be quantified on survey records as CCPM (Corrected Counts Per Minute).

Results that are less than 100 CCPM should be recorded on the survey record as <100 CCPM.

Attachment 4

LARGE AREA WIPES ON TRUCK TIRES

Large area wipes are used to wipe an area of approximately 2000 cm^2 on truck tires. The wipes are then frisked with a PAC-4G.

Assuming that 50 cpm above background is readable, it can be assumed that 100 dpm is detectable on a wipe. If the area of the wipe requires two probe areas to cover the wipe, then it can be assumed that we can assess with each measurement approximately half of the total area wiped, or 1000 cm^2, or approximately 100 dpm/1000 cm^2, which is equivalent to 10 dpm/100cm^2.

Frisk results on LAWs, from truck tires, that are nondetectable may be recorded as <10 dpm/100cm^2 in the removable column of the survey report.

ATTACHMENT 5

LLD CALCULATION

$$LLD = \frac{2.71}{T_s} + 3.29\sqrt{\left(\frac{C_b}{T_b}\right)\left(1 + \frac{T_b}{T_s}\right)}$$

Where C_b = Background Counts Per Minute
T_b = Background Counting Time in minutes
T_s = Sample Counting Time in minutes

EXAMPLE: The background count rate for a given counter is 1.56 cpm over a 50 minute counting time and samples are counted for 2 minutes. The counter has an efficiency of 40.3%.

$$LLD = \frac{2.71}{2} + 3.29\sqrt{\left(\frac{1.56}{50}\right)\left(1 + \frac{50}{2}\right)}$$

$$LLD = 4.32\ cpm$$

$$LLD = \frac{4.32\,cpm}{.403} = 10.7\,dpm$$

ATTACHMENT 6

Beta-Gamma Survey of Truck Tires

The removable contamination limits are 220 dpm alpha contamination and 2200 dpm beta contamination. The most restrictive is the alpha limit. If weather prevents surveying for alpha contamination then beta-gamma surveys will have to be utilized. From attachment 1 table 1 the alpha to beta ratio is 1.8. Using a conservative alpha to beta ratio of 2, the beta equivalent activity for the alpha limit would equal 110 dpm. 110 dpm times the probe efficiency of 0.14 cpm/dpm equals 15.7 cpm. 15.7 cpm above background is not discernable in the field. The diameter of a truck tire is 43 inches. The tread width is 9 inches. The surface area of a truck tire equals 7843.8 cm^2. Approximately 12 inches *of* tread is on the ground ***and*** not surveyable. This represents 3.5% of the surface area of the tire. The remaining 96.5% equals a surface area of 7569.5 cm^2. The typical area of contact for a wipe is about 3.5 inches by 4 inches. This is equal to about 90 cm^2. If the conservative area of 100 cm^2 is used the each cm^2 of wipe is equal to 57.7 cm^2 of tread area. The manufacturer lists the surface area of the probe face as 15.5 cm^2. The tread area survey under the probe equals 894.4 cm^2. To correct the measured counts to an activity/100 cm^2 the counts indicated on the meter face must be multiplied by 8.9. If 15.7 cpm/100 cm^2 beta-gamma activity equals 220 dpm/100 cm^2 alpha contamination then the measured cpm when surveying a wipe would equal 139 cpm. The manufacturer recommends limiting the background ***count rate to less than 300 cpm in order*** to see 100 cpm above background. Due ***to the changing*** background ***conditions*** this ***value*** is being reduced to 200 ***cpm***. Therefore if ***background is 200 cpm*** or less and the wipe on a truck tire reads less than 100 cpm ***above background*** the truck tire has less than 220 dpm/***100 cm²*** removable alpha contamination.

ATTACHMENT 7
REQUEST FOR EQUIPMENT RELEASE

FROM:______________________________ DATE:____________

TO: HEALTH PHYSICS SUPERVISOR

1. Equipment type & ID #_:____________________________________

2. Usage history (locations on site):______________________________

____

____

____

3. *Scheduled date to start decontamination:* __________________________

4. HP check for survey readiness:: Technician:__________ date:__________

5. Equipment ready for survey: YES:__________ NO:______________

Actions required: ______________________________

____

____

6.Date & Time ready for survey: ______________________________

7. Survey date & time: ______________________________

results: Pass:________________ fail:________________

8. equipment release date: ______________________________

9.Approved for release: HP supervisor:________________date:________

NOTE; On large earth moving equipment, substantial cleaning may be required prior to HP checking for survey readiness. Once vehicle has been checked and is ready for release survey, it may take as much as 24 hours from the time the survey is initiated until survey results are available. If fixed or removal is located,additional decontamination and surveys are required.

LINDSAY LIGHT II SITE

Standard Operating Procedure

Title: Decontamination

Document Number: SOP-LLII347

Revision Number: 0

Approved By: *[signature]*

Date: October 23, 1996 **Replaces:** None

DECONTAMINATION

DOCUMENT SOP-LLII347

Reviewed By: ______________________________ Date: ____________

Quality Assurance Supervisor

Reviewed By: ______________________________ Date: ____________

Site Manager

Reviewed By: ______________________________ Date: ____________

Project Manager

DECONTAMINATION

1.0 SCOPE

1.1 Purpose

The purpose of this procedure is to provide instructions for the decontamination of personnel and equipment.

1.2 Applicability

This procedure is applicable for all equipment and personnel that may become contaminated at the Kerr-McGee West Chicago Facility.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 Kerr-McGee Procedure ***WCP-345*** "Surveys for Surface Contamination and Release of Equipment for Unrestricted Use"

3.0 DEFINITIONS

3.1 Airborne Radioactivity Area

This term defines radiation conditions within a specified area. An area where the average concentration of airborne radioactivity could allow an individual to exceed 12 DAC-hrs over a one week period.

3.2 Clean Area

This term defines radiation conditions within a specified area. An area where the radiation levels and contamination levels are maintained below 2 mr*em*/hr and 33 dpm/100 cm^2 alpha respectively.

3.3 Contamination Control Area

This term defines radiation conditions within a specified area. An area that may be contaminated to a level greater than a Clean Area.

3.4 Contamination Reduction Zone

The area ***on one side*** of the Control Line where personnel ***can decontaminate,*** remove their personal protective clothing and equipment. ***(See "Support Zone Layout" drawing #200-CV-007.)***

3.5 Control Line

The ***demarcation*** that separates ***a*** Clean Area from ***a Contamination Control Area. The control line is located in the personnel decon facility.***

3.6 Craft Personnel

Employees and contractors who physically perform the activities described on the SWP.

3.7 Derived Air Concentration-Hour (DAC-hour)

DAC-hour is the product of the concentration of radioactive material in air and the time of exposure to that radionuclide.

3.8 Exclusion Zone

The area ***on one side of*** the Control Line that includes Contamination Control Areas, Radiation Areas, and Airborne Radioactivity Areas.

3.9 Film Badge

Similar to the TLD, it is used to measure radiation dose.

3.10 Frisking

A personal survey of an individual's clothing and exposed body performed to determine if contamination is present.

3.11 Protective Clothing

Reusable or disposable coveralls, boots and gloves that provide a barrier between contamination and personnel.

3.12 Radiation Area

This term defines radiation conditions within a specified area. An area where the whole body radiation level is greater than 5 mrem/hr.

3.13 Special Work Permit (SWP)

A document which describes the radiological conditions of the work area or task and delineates safety and radiation protection requirements to be followed in the work area or when performing the task.

3.14 Support Zone

The area on one side of the Control Line at the entrance to the Exclusion Zone. ***(See "Support Zone Layout" drawing #200-CV-007.)***

3.15 Thermoluminescent Dosimeter (TLD)

A device that measures radiation dose.

4.0 REQUIREMENTS

4.1 Prerequisites

None.

4.2 Tools, Material, Equipment

4.2.1 Decontamination facility.

4.2.2 Soap, water, high pressure spray, scrub brushes and other material as necessary to decontaminate personnel and equipment.

4.3 Precautions, Limits

Decontamination of personnel with material other than soap and water will only be done when authorized by the Site Manager, Health Physics Supervisor, or a medical doctor.

4.4 Acceptance Criteria

4.4.1 Personnel shall be free of contamination after decontamination.

4.4.2 Material and equipment ***being decontaminated, for unrestricted release, shall meet the release limits established in Reference 2.4.***

5.0 PROCEDURE

5.1 Personnel Decontamination

5.1.1 Personnel who are contaminated to greater than 100 *ccpm* shall notify the health physics technician (HPT) assigned to the Control Line.

5.1.2 The HPT shall resurvey the individual to determine the exact location of the contamination and document it on the Contaminated Personnel or Personal Effects Report (Attachment 1).

5.1.3 If the contamination is spotty, the HPT shall attempt to decontaminate the individual using swabs or soap and water. If the decontamination is successful, document the results on Attachment 1.

a. ***If contamination is determined to be in an individual's eyes, the eyes may be flushed, using an eye wash station.***

b. ***If contamination remains in the eyes after flushing or is determined to be in an individual's nose or ears, decontamination will be performed under the direction of the Health Physics Supervisor or qualified medical personnel.***

c. Cleansing methods for skin decontamination, in order of harshness are as follows:

1. Lifting off with sticky tape.

2. Flushing with water.

3. Soap and cool water.

4. Mild abrasive soap, soft brush, and water.

5. Detergent (soap powder).

6. Mixture 50% powdered detergent and 50% cornmeal.

5.1.4 If the contamination cannot be easily removed or the contamination is wide spread, the HPT shall escort the individual to the decontamination facility and notify the Health Physics Supervisor and the Site Manager.

5.1.5 The contamination shall be removed by having the individual wash with soap and cool water several times if necessary. The methods listed above may be used by the HPT.

5.1.6 If the decontamination is successful, document the results on Attachment 1.

5.1.7 If, after several attempts, the contamination is not successfully removed, notify the Health Physics Supervisor.

5.2 Tool Decontamination

5.2.1 All tools being removed from the Exclusion Zone shall be checked by the HPT.

5.2.2 Tools that are contaminated shall be decontaminated before they can be released from the Exclusion Zone.

5.2.3 Tools shall be decontaminated by the users under the direction of the HPT.

5.2.4 Tools can be decontaminated using scrub brushes and soap and water, wiping with damp rags or wipes, soaking in a decontamination solution, using abrasive materials ultrasonic cleaners, or any other method approved by the HPT.

5.2.5 All interior surfaces of the tools must be decontaminated as well prior to the tool being unconditionally released.

5.2.6 If the tool is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet (Reference 2.4).

5.2.7 If the tool cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material and kept in the Exclusion Zone.

5.3 Equipment Decontamination

5.3.1 Heavy equipment, such as backhoes, bulldozers, trucks, cranes, shall be washed with high pressure water spray prior to being surveyed by the HPT.

5.3.2 The washing of heavy equipment shall be performed in an area designated by health physics.

5.3.3 Once the equipment is washed, it will be surveyed by the HPT. The HPT will identify any areas on the equipment that need further decontamination and will make recommendations on how to further decontaminate.

5.3.4 All surfaces of the equipment must be decontaminated and surveyed. This includes air intakes, air filters and any internal surface that is likely to be contaminated.

5.3.5 Once the equipment has been surveyed and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet *(Reference 2.4).*

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Release surveys and personnel decontaminations shall be documented on the appropriate form.

6.2 Personal contaminations shall be reported to the Health Physics Supervisor and the Site Manager.

7.0 ATTACHMENTS

7.1 *Attachment 1 Contaminated Personnel or Personal Effects Report*

ATTACHMENT 1

CONTAMINATED PERSONNEL OR PERSONAL EFFECTS REPORT

DATE OF INCIDENT	TIME OF INCIDENT
NAME	BADGE NO
LOCATION OF INCIDENT (SPECIFIC AREA)	

DESCRIPTION	DESCRIBE IN DETAIL ANATOMICAL LOCATION, CONTAMINANT, TYPE OF INJURY, OR CONTAMINATED ARTICLE:

CONTAMINATED ARTICLE OR AREA	DECONTAMINATION AGENT USED	INSTRUMENT	SURVEY RESULTS BEFORE	SURVEY RESULTS AFTER	FINAL DISPOSITION OF ARTICLES

WOUND COUNT /5 MIN	BKGD COUNT /5 MIN	SOURCE COUNT /5 MIN

SAFETY MEASURES	PERTINENT SAFETY MEASURES IN EFFECT ☐ YES ☐ NO	IF NO, EXPLAIN

REMARKS	

EMPLOYEE SIGNATURE	HEALTH PHYSICS SIGNATURE

STANDARD OPERATING PROCEDURE

SAMPLE PREPARATION PROCEDURE FOR GAMMA SPECTRAL ANALYSIS

Title: Sample Preparation Procedure for Gamma Spectral Analysis

Document SOP-LLI1364

Revision Number: 0

Date: Replaces: New

SAMPLE PREPARATION PROCEDURE

1.0 SCOPE

1.1 Purpose

The purpose of this procedure is to provide guidance for the preparation of samples for analysis of moisture or radioactive nuclides.

1.2 Applicability

This procedure applies to all soil-type environmental samples, including, soil, rocks, concrete, and construction debris.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 West Chicago Project, Health and Safety Plan for Decommissioning activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.3 State of Illinois Department of Nuclear Safety Radioactive Material License Number STA-583

2.4 West Chicago Project, Facility Procedure #WCP-365 "Moisture Analysis"

2.5 West Chicago Project, Facility Procedure #WCP-380 "Use of Laboratory Standard Reference Methods Procedure"

3.0 DEFINITIONS

NONE

4.0 REQUIREMENTS

4.1 Prerequisites

NONE

4.2 Tools, Material, Equipment

4.2.1 The following equipment is needed to perform this procedure:

a. 20 ml sample vials

b. A set of sieves ranging from one-inch to 100 mesh.

c. Bico-Braum Pulverizer

d. Riffle splitter

e. *2 qt plastic jars*

f. aluminum pans

g. 4-inch Braum-Chipmunk Crusher

h. analytical balance

i. Marinelli beakers

j. zip-lock bags

k. labels

l. drying oven

4.3 Precautions, Limits

4.3.1 Personnel are to use extreme caution when using the "Jaw Crusher" and the"Pulverizers" because they can cause a serious injury.

4.3.2 All samples not known to be homogeneous must be homogenized prior to analysis.

4.4 Acceptance Criteria

Proper preparation ensures that the samples submitted to the laboratory are representative of the material sampled and suitable for the requested analysis.

5.0 PROCEDURE

5.1 All Samples

5.1.1 All samples are brought to the sample receiving area and the following information is documented in the *"Sample Prep Log"*.

a. *Number of samples*

b. *Originator of samples*

c. *Date received*

5.1.2 If the samples are not uniquely identified, assign a unique number to each sample and identify the number(s) on each sample and in the Sample Prep. Log.

5.1.3 Prepare the sample in accordance with the requirements of the analysis requested.

5.1.4 Sample(s) received for IDNS and/or USEPA are logged as received in the Sample Prep. Log Book. The appropriate agency is notified to pick up the sample(s) from the site laboratory. When samples are picked up, note the date and time in the Sample Prep. Log Book.

5.2 Lot Samples for Railcar shipment.

5.2.1 The lab technician should: log Receipt of Samples from lots in the Sample Prep. Log Book, then sign the associated Sample Tracking Form.

5.2.2 Label appropriate # of Liquid Scintillation Containers (LSC Vials).

5.2.3 Prepare samples to 20 g ± 0.5 g after homogenizing each sample.

5.2.4 Perform moisture analysis if requested in accordance with reference 2.4.

5.2.5 Perform pH analysis if required in accordance with reference 2.5.

5.3 Shared Samples

5.3.1 If the sample appears to be "dry," divide the sample into 2 or 3 sub-samples (2 if a QA sample is needed; 3 if a QA and an IDNS sample split is also needed) using the riffle splitter. If the samples appears to be "wet", homogenize and manually divide into 2 or 3 sub-samples

5.3.2 Label ***uniquely*** each sub-sample ***and log the numbers in Sample Prep. Log book.***

5.3.3 ***Submit samples for analysis.***

a. Samples for the soil lab shall be 20 ± 0.5 grams and placed into 20 ml vials ***for nutranl analysis.***

b. Samples for the IDNS shall weigh one if prepared by Kerr-McGee.

c. Samples placed in Marinelli beakers shall ***be in a*** 1.00 liter ***geometry.***

d. The net weight of the Marinelli beaker shall be noted on the sample label attached to the beaker. Note: Do not write directly on the beaker.

e. Samples for an outside laboratory or "reserved sample" shall weigh 1000-1100 grams and be placed ***into storage jars and labeled.***

5.3.4 Submit the ***vial*** samples to the soil lab for gamma pulse height analysis by Nal-NURTANL.

5.3.5 Samples for IDNS shall be submitted to state personnel for analysis.

5.3.6 ***If moisture analysis is required perform analysis in accordance with reference 2.4.***

5.3.7 Submit the "Marinelli-beaker" samples for gamma pulse height analysis by GE.

5.3.8 ***Place*** the ***jar*** samples in storage.

5.4 QA Sample

5.4.1 Place the sample in an ***tared*** aluminum pan and weigh before drying.

5.4.2 Dry the sample for 8-16 hours at 105-110°in a drying oven.

5.4.3 Weigh the sample after drying and calculate the moisture content.

$$\% \text{ Moisture} = \frac{\text{weight of water} * 100}{\textit{Net} \text{ weight as-received sample}}$$

5.4.4 Remove non-native, non-crushable debris (including pieces of metal, wood, etc., but excluding crushable brick, concrete, glass, etc.) and detritus (grass, etc.) from the samples.

5.4.5 Samples must pass through a ¼ inch mesh to be acceptable for gamma spectral analysis. Sample components greater than ¼ inch shall be crushed using a 4-inch chipmunk crusher.

NOTE: If sample contains material greater than ¼" crush to less than ¼" with the chipmunk crusher.

5.4.6 Riffle-split the sample down to 3000-5000 grams for analysis by Marinelli beaker, GE Detector.

5.4.7 Using the Bico-Braum Pulverizer, grind the samples to less than 10 mesh.

5.4.8 Blend the pulverized sample by rolling it ***in a jar and place jar in storage for Radon ingrowth.***

5.4.9 ***After allowing time for radon in growth, transfer 1.0 liter of material to a Marinelli beaker and determine net weight.***

5.4.10 Transfer 20 ± 0.5 grams into a 20 ml LSV. Cap the LSV tightly. Place the remainder of the material into a two liter polyethylene bottle. Cap the bottle tightly and label "This is a reserve sample".

5.4.11 Perform Gamma Pulse Height Analysis on samples.

5.5 Verification of Samples

5.5.1 Transfer equal weight of sample from each grid sample point into bucket.

5.5.2 Homogenized sample

5.5.3 Fill labeled sample jar with sample

5.5.4 Transfer 20.0g ± 0.5g to label LSC vial.

5.5.5 Perform moisture analysis in accordance with reference 2.4.

5.5.6 If grid selected for QA Analysis transfer ≈ 3000g of sample to aluminum pan and place into oven for drying.

5.5.7 Place jar into storage and submit Lbc vial for Gamma Pulse Height Analysis.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Notify the laboratory technician when the samples are properly labeled and ready for analysis.

6.2 Samples shall be retained until all evaluations have been completed and the sample is no longer needed.

6.3 Log Books shall be maintained by the Lab Supervisor until complete and then forwarded to Document Control for storage in the project files.

7.0 ATTACHMENTS

NONE

OPERATION OF THE ACCUSPEC GAMMA COUNTER

DOCUMENT SOP-LLI1366

Reviewed By: ______________________________ Date: ____________
Quality Assurance Supervisor

Reviewed By: ______________________________ Date: ____________
Site Manager

Reviewed By: ______________________________ Date: ____________
Project Manager

OPERATION OF THE ACCUSPEC GAMMA COUNTER

1.0 SCOPE

1.1 Purpose

This procedure describes the step for performing gamma spectral analysis of samples utilizing the Accuspec Gamma Spectroscopy system.

1.2 Applicability

This procedure applies to the analysis of samples utilizing the Accuspec Gamma Spectroscopy system.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340,
Standards for Protection from Radiation.

2.2 32 Illinois Administrative Code, Part 400,
Notices Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr- McGee Chemical Corporation Rare Earths Facility, West Chicago Illinois

2.4 PC1-NUTRANL OPERATION MANUAL
KERR- McGEE Technical Manual TM-940035 March-1994

2.5 ACCUSPEC Installation and User's Guide
CANBERRA Program Documentation Version 03 March-1990

2.6 RADIOACTIVE DECAY DATA TABLES
D. C. Kocher

2.7 NaI(Tl) DETECTORS MODEL 802 SERIES
CANBERRA Operator's Manual

2.8 PHOTOMULTIPLIER TUBE BASE/PREAMPLIFIER MODEL 2007P
CANBERRA Operator's Manual

2.9 US-NRC Regulatory Guide 4.14

/

3.0 DEFINITIONS

3.1 None.

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 The Accuspec system is operational

4.1.2 Samples to be analyzed by the Accuspec system must be in the 20 ml liquid scintillation vial geometry.

4.2 Tools, Material, Equipment

4.2.1 Canberra NaI(Tl) detector model 802

4.2.2 Canberra photomultiplier tube base/preamplifier model 2007P

4.2.3 Accuspec gamma spectroscopy program

4.3 Precautions, Limits

4.3.1 Use only plastic liquid scintallation vials 16.7 to 28 mm in diameter.

4.3.2 Power is to remain applied to this equipment. Should power be lost a warm up time of 24 hours may be required upon restart.

4.3.3 Ensure all samples to be analyzed are free from external contamination.

4.4 Acceptance Criteria

4.4.1 Background and Efficiency checks shall be performed daily prior to use.

Kerr-McGee's NUTRANL gamma pulse height analysis software does not employ "target energies" to identify and quantify nuclides. All gamma photopeaks over the range of interest are used. The Packard AccuSpec Gamma Counter system is adjusted to monitor the energy range from 50 to 2,000 keV, inclusive.

The Minimum Detectable activity (MDA) is as follows:

Counting Time	U-238, pCi/g	Ra-226, pCi/g	Ra-228, pCi/g	K-40, pCi/g
[illegible] Minutes	4.6	1.4	1.3	32

MDA calculated in compliance with US-NRC Regulatory Guide 4.14 (at 4.65 times the standard deviation of the analysis for the instrument background).

4.4.2 All efficiency checks shall be within 2 standard deviations from the certified activity of the standard measured.

4.4.3 All samples to be analyzed shall be preceded by analysis of the Uranium, Thorium, Radium, Potassium, and Blank standards.

The calibration standards contain U-238 (in secular equilibrium through U-234), Th-232 (in secular equilibrium with progeny), Ra-226 (in Secular equilibrium through Po-214), pCi/g K-40. The density of each standard is similar to that of lightly compacted soil (1.5 g/cc). The U-238, Th-232 and Ra-226 standards are traceable to NIST. The K-40 standard is not NIST traceable. The blank is chromatographic grade alumina.

4.4.4 The Canberra system measures and records elapsed time, live time and dead time. The NUTRANL, code uses the live time. System dead time is typically 9 to 0% for samples ranging from background up to 1,000 pCi/g Ra.

5.0 PROCEDURE

5.1 INITIAL INSTRUMENTATION SETUP

5.1.1 Connect the equipment cables in accordance with the manufactures technical manual.

5.1.2 From the C:> prompt type "START" and press enter to start NUTRANL.

5.1.3 Enter "SETUP" for the category.

5.1.4 Enter "YYMMDDS1" for the sample ID.

5.1.5 Enter "SYSTEM SETUP" for the description.

5.1.6 Press the "ESC" key.

5.1.7 Open the detector shield assembly, place the 20 gram Thorium Standard in the detector, and close the detector shield assembly.

5.1.8 Select "S" to open the SETUP menu.

5.1.9 Select "V" to open the HVPS menu.

5.1.10 Select "L" to open the VOLTAGE LEVEL menu.

5.1.11 Enter "1000" to set the high voltage to 1000 volts.

5.1.12 Select "N" to turn the high voltage on.

5.1.13 Press the "ESC" key to return to the SETUP menu.

5.1.14 Select "A" to open the ADC menu.

5.1.15 Select "G" to open the CONV. GAIN menu.

5.1.16 Select "2" to set the conv. gain to 2048.

5.1.17 Press "ESC" key to return to the ADC menu.

5.1.18 Select "U" to set the ULD, normally set to 100%.

5.1.19 Set the ULD level using the left and right arrow keys and press "ENTER" to lock the setting.

5.1.20 Press "ESC" to return to the ADC menu.

5.1.21 Set the desired LLD level using the COARSE LLD and the FINE LLD menus.

5.1.22 Press "SHIFT-F2" to erase the current spectrum.

5.1.23 Press "F1" to start acquisition.

5.1.24 Collect a spectrum that will determine the channel location of the 74 kev peak from Thorium.

5.1.25 Adjust the ADC ZERO to place the 74 kev peak in channel 74.

5.1.26 Repeat steps 5.1.23 to 5.1.25 to adjust the ADC ZERO.

5.1.27 Open the detector shield assembly, remove the Thorium standard, place a Cs-137 source in the detector, and close the detector shield assembly.

5.1.28 Press "SHIFT-F2" to erase the current spectrum.

5.1.29 Press "F1" to start acquisition.

5.1.30 Collect a spectrum that will determine the channel location of the 662 kev peak from Cs-137.

5.1.31 Adjust the AMP GAIN to place the 662 kev peak in channel 662.

5.1.32 Repeat steps 5.1.27 to 5.1.30 to adjust the AMP GAIN.

5.1.33 Repeat steps 5.1.23 to 5.1.30 to until both the 74 kev and the 662 kev peaks are in the proper channels.

5.1.34 Record the ADC, AMP, and HVPS settings in the Accuspec Log Book.

5.2 NUTRANL CALIBRATION

5.2.1 From the C:> prompt type "START" and press enter to start NUTRANL.

5.2.2 Enter "CALIB URANIUM" for the Category.

5.2.3 Enter "YYMMDDC1" for the sample ID.

5.2.4 Enter "URANIUM STANDARD" for the description.

5.2.5 Enter 20.0 for the weight of the sample.

5.2.6 Press the "ESC" key.

5.2.7 Open the shield assembly, place a Cs-137 source in the detector, and close the shield assembly.

5.2.8 Press "SHIFT-F2" to erase the current spectrum.

5.2.9 Press "F1" to start acquisition.

5.2.10 Collect at least a two minute spectrum and press "F1" to stop acquisition.

5.2.11 Record the ADC, AMP, and HVPS settings in the Accuspec Log Book.

5.2.12 Adjust the AMP gain settings, if necessary, to align the Cs-137 662 kev peak in the 662 channel and record any changes in the Accuspec Log Book.

5.2.13 Open the detector shield assembly remove the Cs-137 source and place the 20 gram Uranium standard in the detector well and close the detector shield assembly.

5.2.14 Select "A" to open the acquire menu.

5.2.15 Select "P" to open the preset time menu.

5.2.16 Select "L" to open the preset live time menu.

5.2.17 Enter 16 minutes and 40 seconds, 1000 seconds, for the preset live time.

5.2.18 Press the "ESC" key until the main menu is reached.

5.2.19 Press "SHIFT-F2" to erase the current spectrum.

5.2.20 Press "F1" to start acquisition.

5.2.21 Upon completion of acquisition press "M" to open the move menu.

5.2.22 Select "D" to open the data menu

5.2.23 Press "ENTER" to use the default file to transfer the spectrum from.

5.2.24 Enter "F" to name the file to transfer the spectrum and press "enter".

5.2.25 Press "ENTER" to use the default Header.

5.2.26 Press "ENTER" to use the default Eff File.

5.2.27 Press the "ESC" key to return to the main menu.

5.2.28 Press "E" to exit the program.

5.2.29 Enter a "Y" to continue exiting.

5.2.30 When prompted to continue analysis enter a "Y" to preform NUTRANL analysis. The U-238 standard should yield approximately 127,200 counts in 1,000 sec of live time counting. The counter is being calibrated against all photopeaks in the spectrum over the energy range from approximately 50 to 2,000 keV.

5.2.31 The computer will display "U-238 IS DONE. PLEASE START THE TH-232 STANDARD. PRESS ANY KEY"

5.2.32 Press "ENTER" to continue.

5.2.33 Enter "YYMMDDC2" for the sample ID.

5.2.34 Enter "CALIB THORIUM" for the category.

5.2.35 Enter "THORIUM STANDARD" for the description.

5.2.36 Press the "ESC" key.

5.2.37 Open the detector shield assembly and place the 20 gram Thorium standard in the detector well and close the detector shield assembly.

5.2.38 Repeat steps 5.2.19 to 5.2.30. The Th-232 standard should yield approximately 1,070,600 counts in 1,000 sec of live time counting. The counter is being calibrated against all photopeaks in the spectrum over the energy range from approximately 50 to 2,000 keV.

5.2.39 The computer will display "TH-232 IS DONE. PLEASE START THE RA-226 STANDARD. PRESS ANY KEY"

5.2.40 Press "ENTER" to continue.

5.2.41 Enter "YYMMDDC3" for the sample ID.

5.2.42 Enter "CALIB RADIUM " for the category.

5.2.43 Enter "RADIUM STANDARD" for the description.

5.2.44 Press the "ESC" key.

5.2.45 Open the detector shield assembly and place the 20 gram Radium standard in the detector well and close the detector shield assembly.

5.2.46 Repeat steps 5.2.19 to 5.2.30. The Ra-226 standard should yield approximately 1,073,800 counts in 1,000 sec of live time counting. The counter is being calibrated against all photopeaks in the spectrum over the energy range from approximately 50 to 2,000 keV.

5.2.47 The computer will display "RA-226 IS DONE. PLEASE START THE K-40 STANDARD. PRESS ANY KEY"

5.2.48 Press "ENTER" to continue.

5.2.49 Enter "YYMMDDC4" for the sample ID.

5.2.50 Enter "CALIB K-40" for the category.

5.2.51 Enter "POTASSIUM STANDARD" for the description.

5.2.52 Press the "ESC" key.

5.2.53 Open the detector shield assembly and place the 20 gram Potassium standard in the detector well and close the detector shield assembly.

5.2.54 Repeat steps 5.2.19 to 5.2.30. The K-40 standard should yield approximately 14,521 counts in 1,000 sec of live time counting. The counter is being calibrated against all photopeaks in the spectrum over the energy range from approximately 50 to 2,000 keV.

5.2.55 The computer will display "K-40 IS DONE. PLEASE START THE BACKGROUND STANDARD. PRESS ANY KEY"

5.2.56 Press "ENTER" to continue.

5.2.57 Enter "YYMMDDC5" for the sample ID.

5.2.58 Enter "CALIB BACKGROUND" for the category.

5.2.59 Enter "BLANK STANDARD" for the description.

5.2.60 Press the "ESC" key.

5.2.61 Open the detector shield assembly and place the 20 gram Blank standard in the detector well and close the detector shield assembly.

5.2.62 Repeat steps 5.2.19 to 5.2.30.

5.2.63 The computer will display "IS A NEW CALIBRATION DESIRED? "Y OR N".

5.2.64 Enter "Y" to install the calibration data into the data file.

5.2.65 The computer will display "CALIBRATION IS FINISHED. PRESS ANY KEY".

5.2.66 Press "ENTER" to continue.

5.2.67 Record the data and time of the calibration in the Accuspec Log Book.

5.3 DAILY BACKGROUND and EFFICIENCY CHECKS

5.3.1 From the C:> prompt type "START" to start NUTRANL.

5.3.2 Press "ESC"

5.3.3 To Perform the Background Check:

A) Press "A" to open the Acquire Menu.

B) Press "P" to open the Preset Menu.

C) Press "L" to open the Live Time Menu.

D) Enter 3600 to set the live time to 1 hour (3600 seconds).

E) Press "ESC: until main menu is reached.

F) Place an empty vial in the detector assembly.

G) Press "SHIFT-F2" to erase current spectrum.

H) Press "F1" to start acquisition.

I) Upon completion of acquisition press "Pg Dn" until the marker/RDI Screen is Displayed.

J) Press "HOME" to set the curser at channel #1.

K) Press "CTRL-L" to set the left marker at channel #1.

L) Press "END" to set the cursor at channel #2045.

M) Press "CTRL-R" to set the right marker at channel #2048.

N) Copy the total CTS displayed onto the "Lab Instrument Check Sheet".

5.3.4 To perform the Efficiency Check:

A) Press "A" to open the Acquire Menu.

B) Press "P" to open the Preset Menu.

C) Press "L" to open the Live Time Menu.

D) Enter 60 to set the live time to 1 minute (60 seconds).

E) Open the shield assembly and place the check source in the detector and close the shield assembly.

F) Press "SHIFT-F2" to erase the current spectrum.

G) Press "F1" to start acquisition.

H) Upon Completion of Acquisition press "Pg Dn" until the markers/RDI Screen is displayed.

I) Using the arrow keys place the curser at the left start channel of the 88 Kev Peak and press "CRTL-L" to place the left marker.

J) Using the arrow keys place the curser at the right end channel of the 88 Kev Peak and press "CTRL-R" to place the right marker.

K) Copy the net CTS displayed onto the "Lab Instrument Check Sheet".

5.3.5 Forward the "Lab Instrument Check Sheet" for input into the computer.

5.3.6 The computer tracks the background and efficiency check using a 30 Day average and will report when either is outside of ±2 standard deviation.

5.3.7 If the background and efficiency check meet the acceptance criteria, place the instrument in service.

5.3.8 If the efficiency check fails to meet the acceptance criteria then repeat step 5.3.4.

5.3.9 If the Accuspec fails a second efficiency check, place the instrument out of service and notify the Lab Supervisor.

5.3.10 If the data from the Blank Standard indicates a contaminated detector, place the instrument out of service and notify the Lab Supervisor.

5.4 ROUTINE SAMPLE ANALYSIS

5.4.1 At the C:> prompt type "START" and press "ENTER" to start NUTRANL.

5.4.2 If the sources, U-238, Th-232, RA-226, K-40, and the blank, have been run for the day you may skip to step 5.4.54.

5.4.3 Enter "Source Count" for the category.

5.4.4 Enter "YYMMDDXX" for the identification tag whereYY = year, MM = month, DD = day.

5.4.5 Enter "Radium STD" for the description.

5.4.6 Enter "20" for the weight.

5.4.7 Enter "y" for the dry weight.

5.4.8 Press "ESC" to go to the MCA Screen.

5.4.9 Press "A" to open the Acquire Menu.

5.4.10 Press "P" to open the preset menu.

5.4.11 Press "L" to open the Live Time menu.

5.4.12 Press the "300" to set live time to 5 minutes (300 seconds).

5.4.13 Press "ESC" until the main menu is displayed.

5.4.14 Open the shield assembly, insert the EPA tailing *or NBL-75* standard, and close the shield assembly.

5.4.15 Press "SHIFT-F2" to erase the current spectrum..

5.4.16 Press "F1" to start Acquisition.

5.4.17 Upon completion of Acquisition press "M" to select transfer data.

5.4.18 Press "D" to select data.

5.4.19 Press "ENTER" to select the default file to move data from the default file.

5.4.20 Enter "F" to select the destination file.

5.4.21 Enter a "ENTER" to select the default header file.

5.4.22 Press "ENTER" to select the default efficiency file.

5.4.23 Press "ESC" to return to the main menu.

5.4.24 Press "E" to exit.

5.4.25 Enter "Y" to confirm the exit.

5.4.26 At the "Continue with Analysis (Y or N)" prompt enter "y" to perform NUTRANL Analysis.

5.4.27 Upon Completion of the analysis enter "CTRL-E" to exit.

5.4.28 Type "PRINTOUT" and press "ENTER" to print the result.

5.4.29 Collect the printout and review the RA-226 result.

5.4.30 ***For the EPA tailing standard,*** if the value is 309.6 pCi/g to 378.4 pCi/g, (±10% of 344 pCi/g) the result is acceptable. ***For the NBL-75 standard, if the value is 149.4 pCi/g to 182.6 pCi/g, (±10% of 166 pCi/g) the result is acceptable.***

5.4.31 Type "START" and press "ENTER" to enter NUTRANL.

5.4.32 If the RA-226 result was not acceptable:

A) Press "ESC" to go to the MCA Screen.

B) Press "S" to open the Setup Menu.

C) Press "P" to open the AMP Menu.

D) Press "G" to open the Gain Menu.

E) Enter the Gain value determined from the Radium Analysis.

> <u>NOTE:</u> Log the "As Found" ADC an AMP Settings in the "Accu-Spec Log Book prior to adjust the gain.

F) Press "ESC" to return to the main menu.

G) Repeat steps 5.4.15 to 5.4.30

H) Continue step 5.4.31 until RA-226 analysis is acceptable.

I) If unable to adjust gain to bring the RA-226 Value into the specifications of step 5.4-30 notify the lab supervisor and place the Accuspec out of service.

5.4.33 If the RA-226 result is acceptable enter "Thorium STD" for the Description.

5.4.34 Press "ESC" to go to the MCA Screen.

5.4.35 Open the shield assembly, place the EPA Dilute Monazite ***or DH-1 STD*** in the Detector, and close the shield assembly.

5.4.36 Repeat steps 5.4.15 to 5.4.28

5.4.37 Collect the printout and review the Th-232 result.

5.4.38 ***For the EPA Dilute Monazite standard,*** if the value is 135 pCi/g to 165 pCi/g, (±10% of 150 pCi/g) the result is acceptable. ***For the DH-1 standard, if the value is 102.6 pCi/g to 125.4 pCi/g, (±10% of 114 pCi/g) the result is acceptable.***

5.4.39 Type "START" and press "ENTER" to start NUTRANL.

5.4.40 If the Th-232 value was not acceptable:

A) Repeat Steps 5.4.32 A to 5.4.31 D

B) Enter the gain value determined from the Th-232 analysis.

C) Continue at step 5.4.14

5.4.41 If the Th-232 Value was acceptable enter "URANIUM STD" for the description.

5.4.42 Press "ESC" to go to the MCA Screen.

5.4.43 Open the shield assembly, place the EPA Pitchblende ***or DH-1*** STD in the detector and close the shield assembly.

5.4.44 Repeat steps 5.4.15 to 5.4.28.

5.4.45 Collect the printout and review the U-238 result.

5.4.46 ***For the EPA Pitchblende standard,*** if the value is 2457 pCi/g to 3003 pCi/g, (±10% of 2730 pCi/g) the result is acceptable. ***For the DH-1 standard, if the value is 529.2 pCi/g to 646.8 pCi/g, (±10% of 588 pCi/g) the result is acceptable.***

5.4.47 If the U-238 result is not acceptable:

A) Repeat steps 5.4.31. A to 5.4.31 D

B) Enter the gain value determined from the U-238 analysis.

C) Continue at step 5.4.14

5.4.48 If the U-238 result is acceptable enter "Potassium STD" for the description.

5.4.49 Press "ESC" to go to the MCA Screen.

5.4.50 Open the shield assembly, place the Potassium STD in the detector, and close the shield assembly.

5.4.51 Repeat steps 5.4.15 to 5.4.26.

5.4.52 Enter "BLANK" for the description.

5.4.54 Press "ESC" to go to the MCA Screen.

5.4.55 Repeat steps 5.4.15 to 5.4.26

5.4.56 Enter a description to the type of sample i.e. Lot #x, off site soils, etc. for the category.

5.4.57 Enter a sample description i.e. Sample number.

5.4.58 Enter the sample weight.

5.4.59 Enter a "y" or "n" for dry weight.

5.4.60 Press "ESC" to go to the MCA Screen.

5.4.61 Repeat steps 5.4.9 to 5.4.11 to set count time.

5.4.62 Repeat steps 5.4.15 to 5.4.26.

5.4.63 Repeat steps 5.4.52 to 5.4.57 for each sample to be analysis.

5.4.64 Upon completion of sample analysis press "CTRL E" to exit.

5.4.65 Type "PRINTOUT" and press "ENTER" to printout a sample report.

5.4.66 Submit the data printout (see example in Attachment #1) to the Lab Supervisor and H. P. Supervisor for review.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Records

6.1.1 Accuspec Log Book

6.1.2 Accuspec Sample Log Book

6.1.3 Data Printout

6.2 Reports

6.2.1 None

6.3 Notifications

6.3.1 None

6.4 Retention

6.4.1 All the records generated in performance of this procedure shall be retained for the duration of the project.

7.0 ATTACHMENTS

7.1 Attachment #1 Example - Analysis Results Printout

Attachment #1
(Example)

GAMMA-SPEC ANALYSIS RESULTS

Analyzed by West Chicago site procedure #3, Rev. 2

Date Analyzed: 06/15/95 Time Analyzed: 1:25 Category: Source Count Analyzed by:_____
Sample ID: 950615XX Description: Radium Std

Activity is reported on AS RECEIVED basis

Weight grams	U-238 pCi/g	Th-232 pCi/g	Ra-226 pCi/g	K-40 pCi/g	Total Gamma * pCi/g
20.0	2.1 +- 22.2	-0.0 +- 5.8	1740.6 +- 12.9	-66.0 +- 112.2	1676.67 +- 115.2

* Sum of U-238, Th-232, Ra-226, and K-40. Negative values are not part of total gamma.

TEACHERS' RETIREMENT SYSTEM - GMO SITE

STANDARD OPERATING PROCEDURE

Title: Operation of the Ludlum Model 2000 Alpha system

Document SOP-LLII372

Revision Number: 0

Date: Replaces: New

INTERIM CHANGE FORM

Change No. LLII - 022

Document No. 372
Section No. 5.7
Page No. 8.9
Revision No. 0

Requirement: LLII Scoping and Planning Document #372, Section 5.7

1.) Para 5.7.1 first sentence states:

"Using forceps, remove the smear or air particulate sample to be counted from the glassine envelope and load it into a sample planchet."

2.) Para. 5.7.8 states:

"Remove the sample from the planchet, return it to the glassine envelope, and store the sample in the designated location."

Ref. internal audit finding #96-KM-06-09

Change:

1.) Para. 5.7.1 first sentence should read:

"Using forceps, remove the smear or air particulate sample to be counted from ***the envelope*** and load it into a sample planchet."

2.) Para. 5.7.8 should read:

"Remove the sample from the planchet, return it to ***the envelope***, and store the sample in the designated location."

Effective Date: 2/10/97

Approval:

J Dwhite 2/11/97

OFFSITE PROJECT MANAGER DATE

OPERATION OF THE LUDLUM MODEL 2000 ALPHA SYSTEM

1.0 SCOPE

1.1 Purpose

The Ludlum Model 2000 (LM 2000) Alpha System is utilized at the control line area or in the counting laboratory for measurement of gross alpha radioactivity of various types of samples. The system normally consists of an Ludlum Model 43-10 alpha scintillation detector coupled to an Ludlum Model 2000 Scaler. This procedure describes the steps for operating the system.

1.2 Applicability

The LM 2000 system is used primarily for measuring smear samples and radon\thoron working level air samples for gross alpha radioactivity. If necessary, it may be used for the measurement of gross alpha radioactivity of air particulate and water samples in the event that the Gamma Products Model G5000 Gas Proportional Counting System is not available.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 State of Illinois Department of Nuclear Safety Radioactive Material License Number STA-583

2.5 Ludlum Technical Manual for Ludlum Model 43-10 Alpha Sample Counter.

2.6 Ludlum Technical Manual for Scaler Model LM 2000.

3.0 DEFINITIONS

None.

4.0 REQUIREMENTS

4.1 Prerequisites

None.

4.2 Tools, Material, Equipment

4.2.1 Ludlum Model 43-10 Alpha Scintillation Detector

4.2.2 Ludlum Model LM 2000 Scaler

4.2.3 Appropriate calibration standard which is traceable to the National Institute of Standards and Technology (NIST):

a. Eberline electroplated Pu-239 standard (serial number S-4100) or equivalent

4.3 Precautions, Limits

4.3.1 Do not exceed 1500 volts using the H.V. ADJUST ten-turn potentiometer on the front panel of the mini scaler. Photomultiplier (PM) tube damage may result.

4.3.2 Considerable time may be lost waiting for the PM tube and crystal to dark adapt. Always keep the sample drawer in the closed position when not in use to avoid possible contamination.

4.3.3 Operate the LM 2000 only in the LINE Mode as indicated on the operating knob on the front panel. Batteries are not normally installed in the LM 2000.

4.3.4 Before counting any samples, ensure that the daily background and daily efficiency determinations have been performed.

4.3.3 Any adjustments to the high voltage, window threshold, window setting, scaler or detector change out requires a recalibration of the instrument.

4.3.4 In the event of a power failure, a background check and efficiency check is required prior to placing the instrument back in service.

4.4 Acceptance Criteria

4.4.1 The daily background determination passes if the number of counts lies between the ± 2 standard deviation range established by the background control chart.

4.4.2 The daily efficiency determination passes if the number of counts lies between the ± 2 standard deviation range established by the instrument control chart.

5.0 PROCEDURE

5.1 Initial Setup

5.1.1 Apply power to the instrument by turning the operating knob located on the front panel of the scaler to the LINE position.

5.1.2 With the sample drawer in the closed position, ensure that the high voltage is adjusted to the value determined by the most recent plateau curves. If necessary, adjust the high voltage using the H.V. ADJUST ten-turn potentiometer on the front panel of the scaler.

5.2 Plateau Curves

5.2.1 High voltage source and background plateau curves must be generated initially. If, for any reason, either the counting instrument, detector assembly or PM tube is changed, a set of new curves must be run.

5.2.2 On a VOLTAGE PLATEAU form (Attachment 2), record the instrument, observer, date, time, source serial number, and any other pertinent information.

5.2.3 Turn the high voltage to a minimum using the H.V. ADJUST ten-turn potentiometer on the front panel of the scaler.

5.2.4 Apply power to the instrument by turning the power knob located on the front panel of the scaler to the LINE position.

5.2.5 Set an appropriate count time (1 minute suggested) using the timer adjustment switches on the front panel of the scaler.

5.2.6 Place the Pu-239 check source in the sample tray and close the tray, locking it closed with the unlocking knob.

5.2.7 Adjust the ten-turn potentiometer in definitive increments (50 volts suggested), recording the counts and voltage on the "VOLTAGE PLATEAU" form.

NOTE:	Do not exceed 1500 volts. If 1500 volts are exceeded the photomultiplier tube may be damaged. If using the RD-14, do not exceed 1800 volts.

5.2.8 Plot the reading versus high voltage settings on a sheet of rectangular coordinate paper.

5.2.9 Remove the check source from the detector and close the sample drawer.

5.2.10 Repeat steps 5.2.7 and 5.2.8 without the source, for a background

5.2.11 Plot the results of the high voltage background plateau curve on the same plot as the high voltage source plateau curve.

5.2.12 From the graph, choose the high voltage setting which is on the flat portion of the curve with a minimum background count. Set the high voltage to this value.

5.3 Chi-square Test

5.3.1 A Chi-square test must be generated upon initial setup, equipment change out or repair, high voltage adjustment, and monthly.

5.3.2 Obtain the "COUNTER TEST-CHI SQUARED" data sheet (Attachment 1).

5.3.3 Record:

a. Your name

b. The date

c. Time

d. The high voltage setting

e. The source used

5.3.4 Open the sample tray, place the Pu-239 source into the planchet, and close the sample tray.

5.3.5 Set the timer for 1 minute and depress the count button.

5.3.6 Upon completion of the count, record the results on the "COUNTER TEST-CHI SQUARED DATA SHEET," Attachment 1.

5.3.7 Repeat steps 5.3.5 to 5.3.6 until 21 data points have been recorded. Remove the source from the detector. Record this data on Attachment 1.

5.3.8 When all the above data has been entered on Attachment 1, perform the calculations on Attachment 1.

5.3.9 Using the table on Attachment 1, find the value of "P" and record the value on Attachment 1. If the value of "P" falls between 0.98 and 0.10, the counter passes the test. If the value of "P" falls outside of these values, the counter fails the test.

5.3.10 If the counter fails the test, rerun the test. If the counter fails a second time, tag the detector out of service and notify the lab supervisor.

5.4 Background Determination

5.4.1 Perform a 50 minute instrument background check daily.

a. Verify that the LM 2000 is not in a count sequence by insuring that the "count" light is not lit.

b. Open the sample tray by operating the unlocking knob and sliding the tray out of the detector.

NOTE:	The 43-10 is a scintillation detector and is light sensitive. Care must be used not to force or pull sideways when opening the sample tray.

c. Remove any sample that may have been left in the detector and clean the sample tray with a clean cloth.

d. Insert the Pu-239 alpha standard and shut the sample tray by gently sliding the tray into the detector and operating the unlocking knob.

e. Press the count button and verify that the count light is on, indicating that the LM 2000 is in a counting sequence.

f. Counting is complete when the count light is extinguished.

5.4.2 Record the results of the background measurement onto the LM 2000 log and the daily LAB INSTRUMENT CHECK SHEET.

5.4.3 If the 2 sigma error from the daily background does not overlap the 2 sigma error of the previous 30 days background, then the sample tray should be decontaminated and the background should be recounted.

5.5 Efficiency Determination

5.5.1 Following the background measurement, perform an efficiency determination with the Pu-239 alpha standard designated for this purpose using a count time of 5 minutes. The efficiency determination must be performed daily, or if not used daily, prior to each use.

a. Verify that the LM 2000 is not in a count sequence by insuring that the "count" light is not lit.

b. Open the sample tray by operating the unlocking knob and sliding the tray out of the detector.

NOTE:	The 43-10 is a scintillation detector and is light sensitive. Care must be used not to force or pull sideways when opening the sample tray.

c. Remove any sample that may have been left in the detector.

d. Shut the sample tray by gently sliding the tray into the detector and operating the unlocking knob.

e. Press the count button and verify that the count light is on, indicating that the LM 2000 is in a count sequence.

f. Counting is complete when the count light is extinguished.

5.5.2 Log the results of the efficiency determination onto the daily LAB INSTRUMENT CHECK SHEET.

5.5.3 The daily efficiency determination is acceptable if the number of counts lies between the ± 2 standard deviation range established by the instrument control chart.

5.5.4 If the instrument fails the daily efficiency determination the first time, it must subsequently pass two consecutive times before the instrument is considered acceptable for operation.

5.5.5 If the daily efficiency fails two consecutive times, the instrument is placed out of operation until the cause of the failures is investigated. The system is placed back into operation only after:

a. The cause of the failures has been identified and recorded in the instrument log.

b. Efficiencies have been verified or system recalibration has taken place.

5.6 Lower Limit of Detection (LLD) Determination

5.6.1 Use the equation shown on Attachment 3, the Smear Counting Data sheet, to determine the LLD.

5.6.2 Record the LLD on each SMEAR COUNTING DATA SHEET, or printout when available.

5.7 Routine Sample Analysis

5.7.1 Set the desired count time using the timer adjustment switches on the front panel of the mini scaler.

5.7.2 Using forceps, remove the smear or air particulate sample to be counted from the glassine envelope and load it into a sample planchet. For evaporated samples (i.e., liquids), proceed to the next step.

5.7.3 Open the sample drawer.

5.7.4 Position the sample planchet in the center of the sample drawer.

5.7.5 Slide the sample drawer to the fully closed position and lock closed by operating the unlocking knob.

5.7.6 Start the count by pressing the COUNT button on the front panel of the scaler.

5.7.7 At the conclusion of the count, open the sample drawer, remove the sample planchet, and return the sample drawer to the closed position.

5.7.8 Remove the sample from the planchet, return it to the glassine envelope, and store the sample in the designated location.

5.7.9 Attach the printout, if available, to the survey, recording the survey number, instrument background, efficiency, and lower limit of detection on the printout. If no printout is available, record the counts accumulated on the scaler onto the SMEAR COUNTING DATA SHEET (Attachment 3).

5.8 INSTRUMENT OUT OF CALIBRATION

5.8.1 When a instrument is found to be "out of calibration" or fails a daily response check immediately notify the HP Supervisor.

5.8.2 The HP Supervisor shall determine the last date that the instrument passed a daily source response check, or the last calibration date, whichever is later.

5.8.3 Based on the last acceptable source response check or good calibration date, the HP Supervisor shall determine what radiological surveys were performed with the defective instrument.

5.8.4 The HP Supervisor shall determine whether regulatory or general informatior surveys were performed with the defective instrument.

5.8.5 Using previous surveys or previous knowledge of the survey data, the HP Supervisor shall determine whether the surveys taken with the defective meter are acceptable or the surveys must be reperformed. In the case of regulatory surveys the survey shall be retaken, if possible, if resurveying is not possible the HP Supervisor will make a written assessment of the quality of the data.

5.8.6 Source check failures/ "out of calibration" are to be recorded in the instrument log book and a nonconformance report (NCR) shall be initiated per QPM-DOC #9, in order to assess trends.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Lab Instrument Check Sheet

6.1.1 The LAB INSTRUMENT CHECK SHEET is utilized to record the results of the daily background measurement and daily efficiency determination. The information from the sheet is entered into the Health Physics data base.

6.2 Voltage Plateau Form

6.2.1 The VOLTAGE PLATEAU form is utilized to record the data used to generate the high voltage and background plateau curves.

6.3 Smear counting Data Sheet

6.3.1 The Smear Counting Data sheet is utilized to record all pertinent data from smear counting where no printing device is available.

7.0 ATTACHMENTS

7.1	Attachment 1	Counter Test-Chi Squared
7.2	Attachment 2	Voltage Plateau Form
7.3	Attachment 3	Smear Counting Data Sheet

Attachment 1

COUNTER TEST - CHI SQUARED (χ^2)

OBSERVER	DATE	TIME	VOLTAGE SETTING	STANDAR-

COUNT TIME - ONE MINUTE

COUNT	NET COUNT	AVERAGE		
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
TOTAL OF 20			TOTAL	

P	X^2
0.98	8.5
0.95	10.1
0.90	11.6
0.80	13.7
0.50	18.4
0.20	23.8
0.10	27.3

IF P FALLS BETWEEN 0.98 AND 0.10, THE COUNTER IS FUNCTIONING PROPERLY

*DISCARD ONE UNUSUALLY HIGH OR LOW COUNT IN CALCULATING $\bar{n}$.

‡ $\bar{n} = \frac{\Sigma n}{20} = \frac{\quad}{20} =$ ______ ENTER THIS VALUE IN n COLUMN FOR EACH COUNT NUMBER.

$X^2 = \frac{\Sigma(n-\bar{n})^2}{\bar{n}} = \frac{\quad}{\quad} =$ ______ . P = ______ .

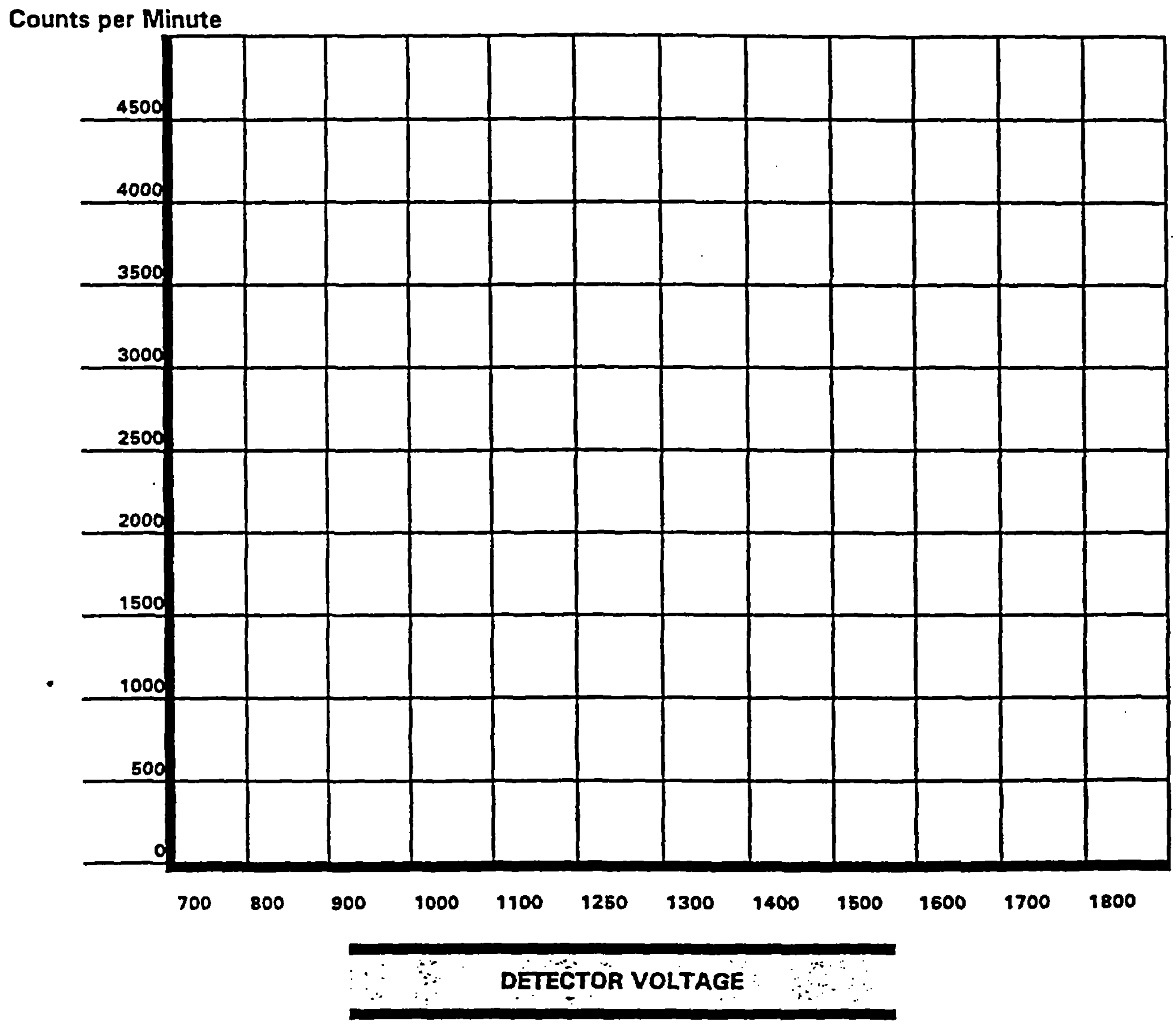
STANDARD DEVIATION FOR A 95% CONFIDENCE LEVEL = (1.96) $\left(\frac{\sqrt{\Sigma(n-\bar{n})^2}}{20}\right)$.

Attachment 2
VOLTAGE PLATEAU FORM
RD-14/LM-2000

Instrument Serial Number ____________ Source Serial Number ______________ Date __________

Pulser Serial Number _____________ Scaler Model Number _____________ Serial Number ____

Technician Name _______________________ Technician Signature __________________________



Attachment 3

SMEAR COUNTING DATA SHEET

TO BE USED WHEN NO PRINTOUT IS AVAILABLE

Instrument Number____________________ **Background**________________
Efficiency__________ **LLD**__________ **Date**________________
Survey Performed By____________________ **Survey Number**________________

Smear Number	Gross Counts per Minute	dpm/100cm2		Smear Number	Gross Counts per Minute	dpm/100cm2

LLD CALCULATION:

$$LLD = \frac{2.71}{T_S} + 3.29\sqrt{\frac{C_B}{T_B} \times [1 + (\frac{T_B}{T_S})]}$$

Where
C_B = Background counts per minute
T_S = Sample count time in minutes
T_B = Background count time in minutes

SMEAR ACTIVITY CALCULATION:

$$A = \frac{(C_C/T) - B}{EFF}$$

Where
C_C = Gross counts
T = Count time in minutes
B = Background counts per minute
EFF = Efficiency

APPENDIX C

341 EAST OHIO STREET SITE

FIELD SAMPLING PLAN

APPENDIX 9

Title: Field Sampling Plan

Revision Number: 1

Date: September 13, 2001 Replaces: New

FIELD SAMPLING PLAN

TABLE OF CONTENTS

1.0 INTRODUCTION

This Field Sampling Plan (FSP) describes the quality-related sampling activities that will be implemented during the excavation activities at 341 East Ohio Street site (Site), located in Chicago, Illinois.

Samples will be collected under the Quality Assurance Project Plan (QAPP) for the following limited aspects of the work:

1. Air monitoring.
2. Sampling excavated backfill soil material to ensure that the material returned into excavations is clean, that is, that the radiological composition of the backfill material is statistically demonstrated to be below the cleanup criteria.
3. Confirmation that material proposed for loading has total radium concentrations greater than 7.1 pCi/g.
4. Local background has been established for total radium (Ra-226 and Ra- 228) at 2.1 pCi/g.
5. Verification sampling to ensure that contaminants which were present above the cleanup criteria have been removed.
6. Material to be shipped for disposal as radiologically-impacted soil does not exhibit hazardous waste characteristics per RCRA.
7. Groundwater removed from the Site for excavation dewatering meets pre-treatment standards for the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC).

The USEPA identified the constituents of concern as the entire thorium 232 and uranium 238 decay chains, including radium-226 and radium-228. This sampling program includes monitoring only for total radium (Ra-226 and Ra-228) in accordance with the Unilateral Administrative Order (UAO).

The characteristic hazardous waste classification analysis per 40 CFR 261.4 will include:

Ignitability	Flash Point
Corrosivity	pH
Reactivity	unstable, reacts violently with water, is sufficiently cyanide or sulfide bearing the produce toxic gas, or is capable of detonation.
Toxicity	TCLP analysis for regulated contaminants

The groundwater analysis will include the parameters specified in Appendix A of the MWRDGC Environmental Remediation Wastewater Ordinance (May 9, 1996).

Waste or Chemical	Concentration (mg/L)
Cadmium	0.11
Chromium (total)	2.77
Copper	2.07
Cyanide (total)	1.20
Fats, Oils and Greases (FOG) (total)	250.0
Iron	250.0
Lead	0.5
Mercury	0.0005
Nickel	3.98
Zinc	2.61
Dichloromethane	0.294
Chloroform	0.309
1,1,1-Trichloroethane	0.193
Trichloroethylene	0.242
Benzene	0.278
Tetrachloroethene	0.225
Toluene	0.247
Ethylbenzene	0.329
Volatile Organic Compounds (total)*	0.567
Total Toxic Organics**	2.13

pH Range - Not lower than 5.0 or greater than 10.0

Temperatures of liquids or vapors at point of entrance to the sewerage system shall not exceed 150°F.

* Total Volatile Organic Compounds shall be the arithmetic sum of the concentrations of:

dichloromethane
chloroform

1,1,1-trichloroethane
trichloroethylene
benzene
tetrachloroethene
toluene
ethylbenzene
acrolein
acrylonitrile
1,3-butadiene
carbon tetrachloride
chlorobenzene
dichloroethane
dichlorobenzene
1-ethyl 2-methylbenzene
napthalene
styrene
1,3,5-trimethylbenzene
vinyl chloride
xylenes
1,4-dioxane
ethylene dibromide
methyl ethyl ketone

** Total Toxic Organics shall be the arithmetic sum of the concentrations of those pollutants found under Title 40 Part 413.02(i) of the Code of Federal Regulations.

This FSP describes the basis for the backfill, air monitoring, verification, and waste characterization sampling programs. It describes sample locations, field sampling and surveying, field instruments, decontamination, and sample management that will comprise the quality-related excavation sampling.

Field sampling activities described in this plan include the following:

- Soil sampling for laboratory analysis of radioactive constituents of concern to document contaminant levels present and confirm excavated spoil soil are below cleanup criteria.
- Air sampling (filter paper) for laboratory analysis of radiological constituents of concern;
- Verification sampling to ensure removal of contamination above the cleanup criteria.

- Onsite management of samples;
- Decontamination; and
- Analytical programs.

The FSP specifies techniques, equipment, and procedures for each activity, number and type of sample, and contingencies that may be implemented during the excavation activities. Standard Operating Procedures (SOPs) that will be followed in the sampling and analyses are included in the QAPP.

2.0 SAMPLE NETWORK AND RATIONALE

This section describes the sampling collection programs and the bases upon which the programs have been developed.

2.1 SAMPLING OBJECTIVES

The objectives of the air sampling program described in this plan are to collect sufficient air samples during soil excavation to assure that excessive airborne contaminated dust is not being released. Air monitoring activities will be conducted within excavated areas to monitor personnel exposures, and at the perimeter of the site to monitor releases to the uncontrolled environment.

The objectives of the soil sampling program described in this plan are to assure that soil used as backfill is clean.

The objectives of the verification sampling program are to ensure that all contamination in excess of the cleanup criteria has been removed. Gamma screening and specific soil testing will be conducted, and the results reported to the U.S. EPA. A complete description of the verification sampling program is included in the specifications attached to the Construction Quality Assurance Plan (CQAP).

The following types of samples will be collected at the Site:

<u>Air Samples</u>

The following air samples will be taken during excavation activities:

- High-volume particulate air samples (for radioactivity) from site perimeter monitoring stations; and
- Samples from personal samplers (for radioactivity).

Backfill Soil Samples

Samples of excavated soil under consideration for use as backfill will be collected in accordance with soil sampling procedure (SOP-214). Statistical analysis will be conducted to document the soil is suitable as backfill.

Sampling will be from lifts, 18 inches or less thick, or from stockpiles, samples in accordance with SOP-214.

Verification Samples

The samples will be collected in accordance with the Soil Sampling Procedure (SOP-214) and the Verification Sampling Plan (Appendix 5 of the Work Plan). One set of 6 subsamples will be analyzed for each 100 m^2 , or less, of excavated area. The subsample set will be prepared from five samples, about 15 centimeters deep (six inches), obtained at the center (one sample) and half way between the center and each corner (four samples).

Waste Characterization Samples

The samples will be collected at locations where previous investigations (May 2000 Koh report) have shown elevated gamma readings. The sampling objective is to evaluate whether these soils exhibit characteristics of hazardous waste that would constrain disposal at the proposed low-level radioactive materials disposal facility.

Samples will consist of ten individual samples from the ten borings distributed across the seven identified locations with elevated gamma readings. Each sample will consist of the fill material above the native sand soil. Samples will be collected in 3-inch diameter split spoons through either hollow stem augers, or if the fill contains sufficient obstructions to constrain hollow stem augers, through borings drilled with solid flight augers.

Dewatering Groundwater Samples

A representative sample of site groundwater will be obtained to document the water quality of water which would be discharged to the Chicago city sewer as part of site dewatering. The objective of this sampling is to evaluate whether the water meets the City's Environmental Remediation Discharge Standards.

The groundwater sample will be from a well located where the excavation will extend to beneath the groundwater table, at the east end of the Site. The well will be a 2-inch diameter PVC well casing and screen with a natural sand sand-pack. The well will be developed by pumping or bailing until pH, temperature and specific conductance are stable (less than 15% variation between successive measurements). The samples will be preserved in accordance with SW-846 methods, stored on ice and shipped under chain-of-custody. The sample will be unfiltered prior to preservation.

2.2 SAMPLE TYPE, LOCATION AND QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

2.2.1 Air Monitoring

The air monitoring program is described in detail in the Air Monitoring Plan, Appendix 8 to the Work Plan.

High-volume air samples will be obtained from perimeter monitoring stations located at four points (north, south, east, and west) around the site.

Air samples will be collected during excavation activities to determine the presence of airborne radioactivity particulates. The air sampling procedure is included as SOP-212 in the QAPP.

Four air monitoring stations will be established at the Site before the excavation begins. Air monitoring locations will be located along the margins of each quarter of the Site at points on the north, south, east, and west sides of the site. Air samplers will be used to collect ambient air particulates on filters for subsequent counting.

2.2.2 Verification Sampling

The verification sampling program is described in detail in the Verification Survey Procedure (SOP 223).

Verification sampling is intended to be confirmatory to the verification gamma scan. Laboratory analyses of sets of 6 subsamples, each consisting of a set of 6 subsamples representing an excavated area of 100 ^{m2}, shall be used to confirm that the cleanup criteria were achieved.

2.2.3 Waste Characterization Sampling

The waste characterization samples will consist of soil and debris encountered above the native sand soil. Samples will be recovered in 3-inch diameter split spoon samples. Samples will be placed in one 1-liter bottle and one 4-ounce jar with teflon sealed lids. Containers will be packed to minimize headspace.

Preservation will be limited to storing on ice. Holding times will be in accordance with SW-846 with extractions before seven days. QA/QC procedures will be in accordance with the laboratory (STL) QAPP, included in the QAPP.

3.0 SAMPLE MANAGEMENT PROCEDURES

3.1 FIELD ACTIVITY DOCUMENTATION

Field logbooks will be used to document daily field activities in accordance to Section 5 of the QAPP. Field logbook documentation procedures are in SOP-215 in this QAPP.

3.2 SAMPLE IDENTIFICATION

All samples collected at the Site will be identified according to the Soil Sampling Procedure (SOP-214).

3.3 SAMPLE CONTAINERS

Sample containers have been selected based on the sample matrix and requirements of the analytical methods. Suitable containers used during the excavation and restoration activities include:

<u>Air Monitoring Station Sampling</u>

- Envelopes of suitable size for glass fiber filters.

<u>Soil Sampling</u>

- Plastic bottles or plastic bags of suitable size for soil samples.

3.4 SAMPLE PRESERVATION

Soil samples to be tested for radioactivity do not require preservation.

Waste characterization samples will be stored on ice and shipped in a cooler, under chain-of-custody, by overnight courier.

3.5 SAMPLE HOLDING TIME

All initial radiological analysis will be performed within six months from the date the sample was collected.

All waste characterization analysis will be extracted within seven days of sampling.

3.6 SAMPLE LABELS

Each container will be labeled with the following minimum information:

- Date and time of sample;
- Unique sample number, including geographic (grid) location;
- Sample volume (air samples);
- Project identification; and
- Name of sampler.

Other information such as weather conditions, sample analysis, and sample preservation may be included on the sample label, as appropriate.

4.0 DECONTAMINATION

All discarded materials, waste materials, and other field equipment and supplies will be handled in such a way to prevent the potential spread of contamination during excavation activities. Discarded items that have contacted contaminated materials will be containerized and transported to the approved disposal facility. Non-contaminated discarded items will collected, bagged, and placed in dumpsters for disposal at an approved landfill.

4.1 PERSONNEL DECONTAMINATION

The following procedure will be implemented for personnel decontamination when work activities are conducted in contaminated areas. This procedure is based on USEPA's Standard Operating Safety Guides, Publication 9285.1-03, PB92-963414 (June 1992).

1. Equipment Drop: Deposit equipment used onsite (tools, sampling devices and containers, monitoring instruments, clipboards, etc.) on plastic drop cloths.

2. Outer Boot and Glove Removal Remove outer boot covers and gloves and deposit in appropriate container.

3. If Respirator Worn - Canister or Mask Change When a worker leaves the Exclusion Zone to change canister or mask, this is the last step in the decontamination procedure. The worker's canister is exchanged, new or clean outer gloves and boot donned, and the worker returns to duty.

4. Boots Gloves, and Outer Garment Removal Boots and outer garment (coveralls) and inner gloves are removed and deposited in appropriate containers.

5. Personal Radiation Survey Perform radiation survey of personnel.

6. Face Piece Removal: If applicable, face piece is removed. Avoid touching face with fingers. The face piece is deposited on plastic sheet.

7. Field Wash: Wash face and hands thoroughly. Shower as soon as possible.

4.2 EQUIPMENT DECONTAMINATION

All sampling equipment will be wiped clean of soil and dust between each use when work activities are conducted in contaminated areas:

4.3 CONTAINER AND SHIPPING CONTAINER DECONTAMINATION

The following general procedure for decontamination of sample containers and shipment packages will be followed:

1. Seal container or shipping package;
2. Wipe container or shipping package with paper and tap water;
3. Allow to air dry; and
4. Perform radiation release survey.